6

March 1982

42 POWER UNIT DATA FOR COMPUTER

D 71639
Canada $1.95
60p

Electronics & Computing MONTHLY

Britain's **First** Electronics & Computer **Applications** Magazine

COMPUTER AIDED CIRCUIT DESIGN

SLIDE PROJECTOR INTERFACE

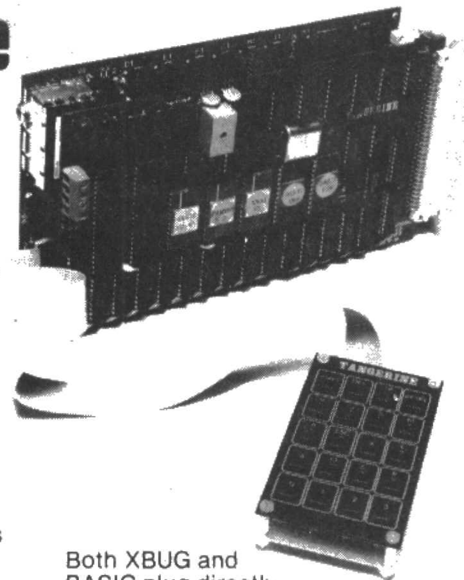
FOUR RAIL MICRO POWER SUPPLY

STATIC AERO GENERATORS

UK 101 MINI VENTURE

UPDATE ON MICRO-COMPUTERS

Step by step with the computer system designed for tomorrow.



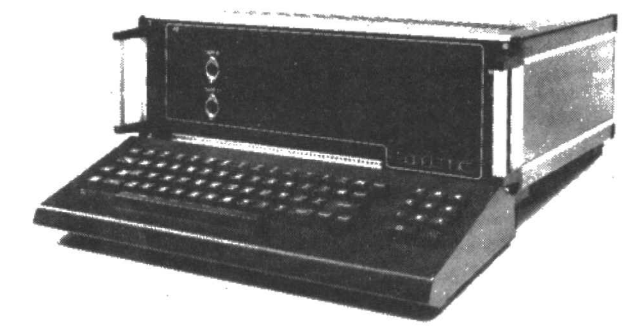
Microtan 65

£79·00 +VAT Ready Built

£69·00 +VAT Kit

* ★ 6502 Microprocessor
* ★ 2K Monitor TANBUG
* ★ Intelligent socket accepts keypad or full ASCII Keyboard
* ★ Chunky Graphics and Lower Case Options
* ★ Connects to unmodified B/W or Colour TV

For the first time buyer or experienced user, Microtan 65 is a superb route into personal computing. If you are looking for a sophisticated machine with the capability of expansion into a professional system, then this is the computer for you. Step by step with the computer system designed for tomorrow. . . .



6502 Microprocessor

Probably the most popular CPU (central processing unit) for personal computers, having a powerful instruction set and architecture.

2K Monitor TANBUG

The built-in 'mind' of the machine, TANBUG controls all system functions and gives comprehensive machine-code facilities. Functions include:- set and clear breakpoints, single step through program, execute program, copy block of memory, modify memory locations and much more.

Intelligent keyboard socket

For absolute beginners we can supply an easy to use 20-way Hex keypad; for the more experienced user there is a full typewriter style ASCII keyboard. Either way, Microtan will work out exactly which type you are using and act appropriately.

Chunky Graphics Options

For drawing simple lines and graphs,, or for animated games, Chunky Graphics is a low cost answer. This set of chips plug into the Microtan board and allow graphics to be built up on the screen at a resolution of 64 rows by 64 columns.

Lower Case Option

To extend the character set to 128 characters, allows for real descenders on lower case characters and a set of extra symbols and characters for simple graphics.

Microtan Accessories

20-way Hex keypad MPS 1 Basic power supply

Aerial connector lead

Full ASCII Keyboard MPS 2 Full system power supply Mini — motherboard

Microtan is available ready-built or as a kit. We recommend that you should have some soldering experience before attempting the Microtan Kit, although if you do run into problems you can make use of our "Get you Going" service (telephone for details).

TANEX

* ★ 7K Static Ram
* ★ 10K Microsoft Basic
* ★ 32 Parallel I/O lines
* ★ 1 Serial I/O port
* ★ XBUG
* ★ Cassette Interface

The first step in expanding your system. Tanex provides the extra facilities necessary for the serious programmer. Memory expansion: Tanex has provisions for up to 7K of static RAM and up to 14K of EPROM using 2716 or 2732 chips.

XBUG and BASIC

XBUG is a 2K extension to TANBUG that contains a mnemonic assembler and disassembler and cassette firmware running at 300 Baud CUTS, standard or high speed. 2400 Baud Tangerine standard with 6 character filenames. Tangerine have taken out a full O.E.M. licence for Microsoft BASIC, the microcomputer industry standard, this is a full feature implementation with interrupt and machine code handling, and a superb program editor. Both XBUG and BASIC plug directly into Tanex and are supplied with comprehensive user manuals.

Parallel I/O

When fully expanded Tanex includes two V.I.A.s (Versatile Interface Adaptors) which implement the cassette interface and the parallel I/O ports. Software in TANBUG V2.3 enables you to plug in and use a Centronics type printer. The two V.I.A.s also contain counter timers that can be used for a variety of applications enhanced by the use of the integral handshake facilities.

Serial I/O

Also on the expanded board is a serial I/O port that can be used to interface RS232 or 20Ma loop terminals or VDU's, again all controlled by TANBUG V2.3.

tangerine
computer systems ltd
Forehill Works, Ely,
Cambs. CB7 4AE.

TO TANGERINE COMPUTER SYSTEMS LTD., FOREHILL WORKS, ELY, CAMBS. CB7 4AE.

PLEASE SEND ME:

- ☐ MICROTAN 65, READY BUILT **£92.35** incl. VAT+P&P.
- ☐ MICROTAN 65 KIT **£80.85** incl. VAT+ and P&P.
- ☐ TANEX (MIN CONFIG) KIT **£50.95** incl. VAT and P&P.
- ☐ TANEX (MIN CONFIG) ASSEMBLED **£62.45** incl. VAT and P&P.
- ☐ EXPANDED TANEX KIT **£104.66** incl. VAT and P&P.
- ☐ EXPANDED TANEX ASSEMBLED **£116.16** incl. VAT and P&P.
- ☐ PLEASE SEND ME THE NEXT SIX ISSUES OF TANSOFT GAZETTE AT **£15.00**.

I enclose my cheque for £ ....

or debit by Access/Barclaycard

....

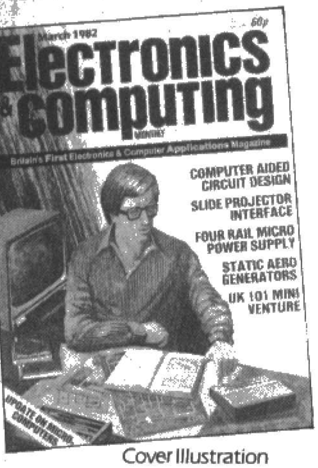
Signature ....

Name ....

Address ....

....

.... (Block capitals please) ECM3



Cover Illustration by Glenn Price

Editorial/Circulation Control
67 High Street,
Daventry, Northampton.
NN11 4BQ
Tel: 03272 71841

Publisher/Editorial Director
David Raven

Production Editor
Glenn Price

Editorial, Consultant
Trevor George

Group Sales Director
R.E. Pynegar

Advertising
(03272) 71702

Circulation & Office Manager
Diana Ward

Subscription Control
Suzanne Gilbert

Distribution
Seymour Press Ltd
334 Brixton Road
London

Published by
Stagpark Limited
Russell Anderson House
18 Hamilton Road
Nottingham

Production
Newstead Publishing Ltd
Nottingham

Printed by
LSG Lincoln

In this months issue

SLIDE PROJECTOR INTERFACE
An inexpensive way of storing static praphic images to supplement lectures, computer aided learning, training, advertising or sales promotions with out the need of a human operator. **18**

GENIE PROJECT
This is a useful circuit which demonstrates an application for putting a taped instruction into an EPROM. **23**

MEMORY
Some of the traumatic experiences Ian Sinclair encountered having decided to take the risk to expand a TRS 80 to 48K. **25**

COMPUTER AIDED DESIGN
The first in our series of CAD programmes on a ZX81 with 16K and printer. Given a design of circuit and values it is simple to evaluate THE EXACT PERFORMANCE, BUT IT IS VIRTUALLY IMPOSSIBLE to start from a desired characteristic & calculate the exact values of components to produce it-but a computer does help. **27**

MICRO-COMPUTER UPDATE
An in depth look at the small computer market. **30**

IN SEARCH OF GOLD

Designed to run on a UK 101 with monitor & 7K of Ram you'll be meeting strange things inhabiting the caves to stop you getting the treasure. **36**

THE HOME COMPUTER AS A TEACHING AID

One of the beauties of this programme is that the child does not need to be able to name the particular letter appearing on the screen, it's a simple case of shape recognition. **38**

FOUR RAIL POWERSUPPLY

A reasonably heavy duty unit that is fairly compact and should fit into the larger types of cases which can double up as a general purpose power supply. **42**

AERO GENERATORS

Generating electricity mechanically from the wind is well known. Gyroscopic strain forces can be a problem involving high rectification costs which compare unfavourably with static generators. **46**

KIT REVIEW

A step by step guide to building a logic probe making a useful piece of test equipment for digital repair work or commissioning new circuits. **48**

TALKING SHOP

News & Views that you are not always meant to hear from inside the electronics industry. **58**

SOFTWARE

Part six of Mike James's feature on Building Basic to help you write your own programmes. **61**

NEWS

7 International News
11 Electronic Components News
13 Computer Product News
41 Special Offer
65 Book Shop
67 Book Review

Electronics & Computing Monthly is normally published on the second Friday of each month.

COMMENT

Chapter Three — 16-bit and applications

Historians of electronics and computing will not need reminding of past technological events however, many of the younger readers may enjoy a short recap.

Chapter 1 concerned the major advances in silicon technology which occured in the late fifties and early sixties. This event culminated in the USA landing two men onto the surface of the Moon — 20th July, 1969. It also marked a new stage in the evolution of semi-conductor technology, the arrival of 'large scale integration' (LSI) and Chapter 2. From this same process evolved the microprocessor and supporting devices for the micrcomputer. In 1975/76 each month revealed a new process or piece of high technology:-

Nov-75 - First use of 16K RAM chips in a commercial computer system.

Feb-76 - First samples of 16K RAMs enter the market.

Mar-76 - First commercial ROM to hit 32K level is marketed.

May-76 - First of the enhanced 8-bit general purpose microprocessors appear.

Sep-76 - First commercial bubble memory production starts with a 92K device.

With the aid of the excellent chronology published annually in 'Electronics International' I could continue recording firsts upto this present time. Chapter 2 then was all about developing devices to build-up the complete microcomputer system, now we come to Chapter 3.

While device technology continues to forge ahead and plays a leading role in the expansion of the hardware systems a limiting factor is the development of software. We will see more emphasis being given to the software development of existing systems and increased applications packages.

Machines that can run on wide range of software will be in demand making them less dependant on a particular programming language.

In order to provide the large memory which these machines require, manufacturers are turning to 16-bit microprocessors (see Jan 82 issue of 'Electronics & Computing Monthly'). Although the first 16-bit devices were launched back in 1978, they are only just beginning to make an appearance in microcomputers. The ACT SIRIUS 1, launched at the 'Which Computer Show' in January, and featured in our new products section this month, is highly rated and threatens to stir up trouble for both PET and APPLE. Tandy have also announced a 16-bit machine by the end of 1982 and it is very likely there are others under wraps.

All of these developments are of course, quite typical of the electronics industry and it certainly doesn't pay to hang around waiting for whats coming next. If you've made a decision to buy a micro' then don't be put off, otherwise you will never get started. One other cautionary note to bear in mind is it often takes quite a while to get things right with a new high technology product and although the specification looks very attractive, delivery and support may not always be as well established.

On the subject of development and the problems companies run into with the design of custom made logic chips, it was disappointing news to hear that the BBC machine would not be available in time for the start of the series. The program went on the air on January 14th screened specifically at Schools. Only 300 of the promised 500 BBC Micro's were in position, and there still doesn't seem any likelyhood of the general public obtaining them before the end of March.

We ourselves have ordered one through a private individual, in order to get a standard production model, so that may explain our lack of reviews etc, on this very promising machine.

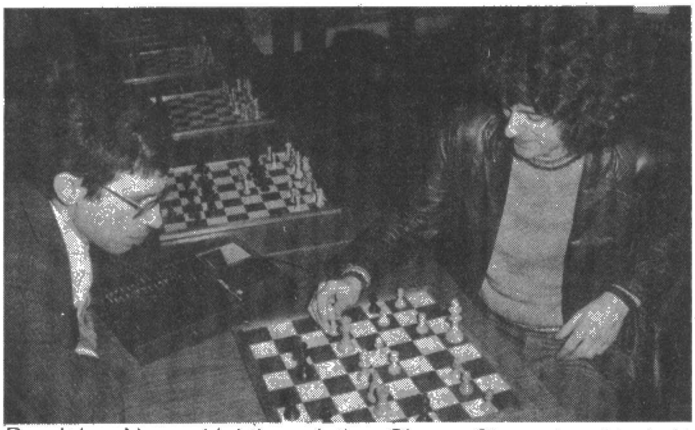
I personally can think of very few occasions when developments using custom designed chips are ready on time and it would surely be more sensible for manufacturers to take this into account, with launch dates. The problems that I see having resulted for both Acorn and the BBC is that they have now soured the massive public enthusiasm for their product which resulted in thousands of orders being placed with virtually no advertisement cost involved. In addition it hasn't done much good to the sales of the Acorn Atom which despite the announcemet of the BBC machine, is highly rated and regarded as a reliable home computer. Perhaps with hindsight it would have been better to have kept the BBC Micro under wraps for a bit longer and produced a less ambitious model based around an existing Micro with a proven track record. Still I suppose we can all be wise after the event.

The result of our request in previous issues for articles, projects and software, has been very encouraging and we would like you to continue sending them in. I am afraid we have slowed down in our response to reader's correspondence, almost in direct proportion to the increase in our magazine sales. To this end we are installing — yes you've guessed it — a microcomputer. With the aid of this new wonder machine which will cost — an arm and a leg — I can hopefully speed up my personal response to readers. If it all works correctly you won't even know if it's me writing to you or the impersonal word processor. I am quite certain however, that there will still be plenty of readers and contributors who still receive one of my hastily hand-written notes. It would surprise readers to learn how un-computerised ediorial offices of computing magazines are.

One final note, our apologies to a certain gentleman living in Bolton whose telephone number appeared in an advertisement last month for Knights TV of Aberdeen. The incorrect dialing code published resulted in Mr X from Bolton, receiving dozens of telephone calls intended for Knight's.

Dave Raven

Publisher



Dr. John Nunn (right) and the Chess Champion Mark V computer ponder over the Russian problem, watched by International Master David Levy.

Chess Experts Embarrassed by Computer

Hot on the heels of our Computer Chess feature (January issue) which predicted the growing challenge of computers against the grand masters. We now have a report of a chess computer outsmarting several leading Russian chess experts. Soviet chess problem expert, L. Zagorujko, won first prize in an important competition in 1972. By composing a particular chess problem for which a distinguished panel of judges was not able to find a solution — apart from the one proposed by Zagorujko himself. A chess problem must have only one possible solution in order to win such a competition. After nearly ten years have passed since the competition and the problem has appeared in many newspapers and magazines around the world (without any solutions having been published) a chess computer the Chess Champion Mark V has come up with not just one but three correct solutions. International chess experts were said to be astounded by the machines discovery during a "man-versus-machine" chess problem-solving contest at the end of a chess tournament held in Brighton. The Mark V, manufactured by Scisys Computers Ltd., was competing against International Master Dr. John Nunn. The Zagorujko problem was one of six 'brain-teasers' shown to Nunn and the Mark V by Mr Barry Barnes, Vice President of the Problem Commission of the World Chess Federation. Nunn eventually gave up on the Russian's problem, saying he felt there was probably more than one solution but he could not find it. The Mark V however continued and produced Zagorujko's solution plus two others.

British Firm Launch Heart Rate Meter

A British company based in New Barnet has developed a new battery powered heart — rate meter for use by Athletes. A photo electric sensor clips on a finger with the instrument strapped to the wrist during exercise. The first reading is made about 10 seconds after the meter is attached and it is calibrated to indicate on a scale from 30 to 200 pulses per minute.

The instrument is said to be very useful in determining the maximum natural heart-rate of athletes under sustained maximum effort and also the recovery of heart-beat to normal level after extertion.

Further information can be obtained by telephoning George Dudley Sports, 01-440 0910.

Milton Keynes User Group First Seminar

In an effort to spread the gospel of computers and information technology, Milton Keynes User Group have held a Saturday Seminar/Workshop. Over 75 people attended and seminars were held on "Micros in Education", ZX81 Guide, Atom Review and Speech Synthesis. In addition there was a Sharp Computer review, Micros in Busines, TRS80. Several trade stands were also in attendance.

Due to the good response to the pilot workshop, plans have now been made to hold quarterly Saturday Seminars. Milton Keynes User Group meets weekly on a Tuesday evening at Woughton Centre, Milton Keynes. Their meetings include short sessions on such subjects as assemblers, basic operating systems etc; which are optional, while the rest of the group develop software games in addition to more serious programs. Anyone is welcome with or without a machine and for more details contact John Chewter Milton Keynes 676996.

Telephone Terminal Development between ICL and Sinclair

A new sophisticated telephone terminal is to be jointly developed by a joint venture link up between Sinclair and ICL. Incorporated in with the system would be Sinclair's own flat-screen TV display which is currently still under development. ICL also announced in a report published in the Financial Times that they planned to manufacture a personal computer designed by RAIR, a British company. This particular computer is designed for the small business market.

The desk-top terminal to be developed with Sinclair would have a built in screen about 12 inches across and 1 inch deep. It would be used to display information transmitted from one computer terminal to another also for voice communication. The terminal naturally lends itself to be incorporated in to an electric mail system. Plans by Sinclair to start production of the flat-screen TV are due to start in about six months time at a factory in Scotland. Initial output is expected to be 1m screens annually rising to 3m by the end of next year.

Computer Open Days to be Held in key Cities

Exhibition specialist Couchmead Communications Ltd; is to hold a one-day computer exhibition almost every fortnight throughout 1982. The exhibitions, called Computer Open Days, will be held in key cities throughout the country. John Godley, managing director of Couchmead explained that each Computer Open Day will have about fifteen exhibitors who will collectively show a broad range of computers and peripheral services. Each show will open from 10.00 a.m. to 5.00 p.m. and admission will be by ticket obtainable free from the exhibitors and the organisers.

Godley confidently expects an average attendance of around 400 at each show "We have already held three Computer Open Days this year, and these have attracted an average of 200 visitors with little advance publicity," he said. The computer industry's response to the Computer Open Day idea has been very encouraging," Godley added. "The Open Day concept offers companies an inexpensive way of exhibiting their products and services regionally, and a number of firms have already booked for the whole series.

The Computer Open Day Programme for the first four months of 1982.

JANUARY
13th: SOUTHAMPTON, Polygon Hotel, Cumberland Place.
27th: CHELTENHAM, Queen's Hotel, The Promenade.

FEBRUARY
10th: HARROGATE, Majestic Hotel, Ripon Road.
24th: SWANSEA, Dragon Hotel, The Kingsway.

MARCH
10th: NOTTINGHAM, Albany Hotel, St. James's Street.
24th: IPSWICH, Great White Horse Hotel, Tavern Street.

APRIL
14th: WESTON-SUPER-MARE, Grand Atlantic Hotel, Beach Road. 28th: MANCHESTER, Grand Hotel, Aytoun Street.

Other venues planned include: Rugby, Taunton, Newport, Glasgow, Sheffield, Liverpool, Edinburgh, Birmingham and Newcastle-upon-Tyne.

Further information on the Computer Open Day series of exhibitions may be obtained from Couchmead Communications Ltd., St. Bernards House, Stoney Lane, London, SE19 3BU, tel: 01-653-1101, up to 23.12.1981, and at their new address: Couchmead House, 153 High St., London, SE20 7DS, tel: 01-778-1102, from 23.12.1981.

Videodisc Concept Slow to Get Going

Video Disc Players which have been hailed as the next generation of video recording systems which could possibly replace tape are not catching on as quickly as manufacturers would have liked.

The first of these machines to successfully hit the market was from the entertainment group RCA. After a major investment program of £100m to develop a video disc system RCA have announced cut backs in their production targets. RCA have sold 60,000 units since their machine was launched which is substantially below their target figure of 200,000 forcast when the video disc player went on sale eight months ago.

The company say they have actually produced in excess of 135,000 units however many of these are still held in stock by suppliers and are said to subject to heavy discounting. New disc titles are being launched all the time by RCA and it is hoped that by the year end their will be more than 300 to choose from.

Video Genie Prize Winner

The lucky winner of our Video Genie competition was picked out from many thousands of entries by Mr Robert Stead of Lowe Electronics.

The splendid prize was won by Mr B. C. Towers, of 63, Brook Hall Road, Ipswich. Congratulations.

MIRO-CHIP THEFTS CAUSE CONCERN

Thefts of a new kind are worrying manufacturers and the authorities in the USA. This new type of crime has recently involved the removal of £1.4m worth of semiconducter devices from Monolithic Memories Incorporated a Californian based component manufacture (Financial Times) Thefts from the major manufacturers in Silicon Valley are not now uncommon and it is reported that they are losing on average £10.2m worth of goods a year. This most recent theft at Monolithic is reported to be unusually large. Thieves took more than 450,000 circuits and only required a small van to cart them away.

The devices stolen were all ready for shipment and had been completely tested to military standards. The concern of the company and undoubtably the American authorities is that there could be some International involvement and that the devices could end up behind the Iron Curtain. The problems facing manufacturers is severe since extremely valuable devices can simply be carried away in a persons pocket.

continued from page 54

```
 930 PRINT "SELECT OPTION REQUIR
ED"
 940 PRINT TAB 8;"1   RERUNPROGR
AM"
 950 PRINT TAB 8;"2   RETURN TO I
NDEX"
 960 INPUT A(1)
 970 IF A(1)=1 THEN GOTO 700
 980 IF A(1)=2 THEN GOTO 35
1000 CLS
1010 REM "BAL SHEET"
1015 LET A(18)=A(14)+A(18)
1020 LET A(20)=A(16)+A(15)-A(18)
1025 LET A(19)=A(12)-A(14)
1040 LET A(17)=A(16)+A(15)
1045 LET A(14)=0
1060 LET B(4)=B(4)+1
1064 IF B(4)=13 THEN LET B(3)=B(
3)+1
1065 IF B(4)=13 THEN LET A(16)=A
(22)
1066 IF B(4)=13 THEN LET B(2)=B(
2)+1
1067 IF B(4)=13 THEN LET A(18)=0
1068 IF B(4)=13 THEN LET A(17)=0
1069 IF B(4)=13 THEN LET A(19)=0
1071 IF B(4)=13 THEN LET A(15)=0
1072 IF B(4)=13 THEN LET A(20)=0
1075 CLS
1079 IF B(4)=13 THEN LET B(4)=0
1080 PRINT TAB 8;" BALSHEET ";B(
2)
1085 PRINT "MONTH NUMBER ";B(4)
1090 PRINT "TOTAL B/F FROM";B(3)
;"=";A(16)
1095 PRINT "TOTAL PAY=";A(15)
1100 PRINT "TOTAL=";A(17)
1110 PRINT "TOTAL EXP=";A(18)
1120 PRINT "MONTHLY BAL=";A(19)
1130 PRINT "CURRENT BAL=";A(20)
1140 PRINT TAB 8;" BAL C/F "
1150 PRINT TAB 8;" LLOYDS ="
;A(10)
1160 PRINT TAB 8;" HBS ="
;A(2)
1170 PRINT TAB 8;" SUN ="
;A(21)
1171 LET A(22)=A(10)+A(21)+A(2)
1175 PRINT TAB 8;" TOTAL ="
;A(22)
1210 PRINT "SELECT OPTION REQUIR
ED"
1220 PRINT TAB 8;"1   RERUN PROGR
AM"
1230 PRINT TAB 8;"2   RETURN TO I
NDEX"
1240 INPUT A(1)
1250 IF A(1)=1 THEN GOTO 1075
1260 IF A(1)=2 THEN GOTO 35
1270 CLS
1280 PRINT TAB 8;" SAVE ON TAPE "
1290 PRINT
1300 PRINT TAB 5;" PREPARE TAPE R
ECORDER "
1310 PRINT
1320 PRINT TAB 5;" WHEN READY PRE
SS CONTINUE "
1330 PRINT TAB 5;" AND NEWLINE "
1340 STOP
1345 SAVE "HOME BUSINES "
1350 GOTO 35
```

THE DREADED GOLF PROGRAM

In the December issue of E&CM we published a "'Golf Program" which caused a few tears. An amended version was again published in the January issue however, several readers still found problems with it. We suspect the ZX81 keyboard may be the cause of some of the errors. (we have a full size keyboard) also the fact that it is a very long listing may have produced further errors.

For readers who only purchased the January issue we have printed below additional notes which should provide all the answers.

This program does work — honest — we have seen it in action also, it has been laoriously keyed in again from the magazine.

1

REM

Graphic T

Inverse K

Y

Graphic A

NOT (Function N) – Four times

((Left bracket – Shift I)

IF (Use Shift 3 to get "THEN", press U to get "IF" then RUBOUT "THEN")

TAN (Function E)

2. The graphic character used in Line 1070 is a graphic H twice.

The graphic character at Line 1160 is a graphic B (inverse*). This is also used at lines 1255 and 1730.

Line 1340 is six "inverse spaces"

Line 1705 is "inverse H"

Line 1710 is "graphic H"

Line 1715 is "graphic A"

Line 1720 is "inverse space"

Line 1725 is "full stop"

Line 1730 is "inverse*"

Line 1735 is "space"

Line 1005 says GOTO 1105 which does not exist. This does not matter as BASIC will automatically continue to Line 1110.

136 New Words from Celdis for DIGITALKER Speech Synthesis System

A new Read Only Memory (ROM) chip set is now available from Celdis which adds a further 136 new words to the standard vocabulary for National Semiconductor's DIGITALKER speech synthesis system. Known as the DT1057, the chip set comprises two 64K ROMs which contain the new 136 words as well as the 138 words previously available.

Essentially, DIGITALKER comprises a speech processor chip and the speech ROMs which, when combined with an external filter amplifier and speaker, forms a system that will generate high-quality speech, including natural inflections (such as local accents). The SPC is capable of directly accessing up to 128K-bits of memory (I.E. the two 64K-bit ROMs which form the DT1057), however, for applications requiring additional vocabulary, the memory addressing capability can be expanded with a minimal amount of external logic.

Other DIGITALKER chip sets available from Celdis include the DT1000 Evaluation Kit with a 138 word vocabulary, the DT1051 Evaluation Kit with an 18 word vocabulary and the DT1052 Kit with Basic numbers. These kits allow designers and engineers to evaluate the DIGITALKER chip sets prior to designing them into an end product.

The DT1000 Evaluation Board contains all the necessary components required to output high-quality speech, including an SPC controller, two speech ROMs, linear filter, 0.5W audio amplifier, keyboard and COPS*f* processor, complete with the necessary explanatory data. The only external hardware required to operate the kit is a single 7-11V d.c. power supply and a speaker chosen for the size and quality required.

The two speech ROMs provided with the DT1000 contain the original 138 word vocabulary consisting of numbers, letters of the alphabet, a selection of useful nouns, verbs and tones and five different individual silence durations of 20mSec, to 320mSec in length. The silence durations are provided to allow phrases to be constructed with variable pauses between words. This can also be of help when joining two words together to form one, such as 'milli ampere', where a period of silence between the two words adds to the overall authenticity.

The kit can be operated in six different operating modes, each controlled by programs resident in the COPS processor. Each mode is selected by entering a pre-defined key sequence on the keyboard. These modes include automatically outputing each word in the library sequentially, repeating a selected word, building up and storing short phrases for later output, outputing a 'canned' phrase in which selected words can be changed, a simple game and outputing the hexadecimal equivalent of a decimal number input.

All DIGITALKER chip sets can be easily interfaced to most popular microprocessors for integration into a complete system. Typical applications will include teaching aids, clocks, telecommunications, computer games and a wide range of consumer products.

For further information:
Celdis
37 Loverock Road
Reading
Berks
RG3 1ED
Telephone: (0734) 586191

New Low-Power Version of Z80

Zilog have just introduced a new version of their Z80 8-bit microprocessor which consumes only 10% of the power of the standard Z80. Known as the Z80L, the new processor is available for operation at clock rates of 1 MHz, 1.5 MHz, or 2.5 MHz as identified by the suffix L1, L2 or L3 respectively.

Power consumption for the Z80L family is 75mW, compared with 500 to 750mW for the standard part, and is therefore suited for use in hand-held or portable battery powered products. By the same token, the low power consumption allows battery backup to be implemented easily in systems or where the application relies on continuous processing.

Another important feature of the Z80L is its full pin and software compatibility with the Z80 allowing it to be used in existing circuit boards without the need for expensive circuit re-design. In addition, the new device is fully supported by Z80 development systems and in-circuit emulators allowing products based on the Z80L to be developed, tested and debugged quickly, thus reaching the market place in the shortest possible time.

The Z80L can be used with the complete range of Z80 8-bit peripheral devices currently offered by Zilog. In the near future a new range of low-power peripherals will be announced including versions of the PIO (Parallel input/output), SIO (serial input/output), CTC (counter/timer circuit) and DART (dual asynchronous receiver/transmitter). These devices will consume about 10% of the power of currently available products at prices substantially lower than CMOS equivalents.

The Z80L family employ a single +5V power supply and operate over the temperature range 0 to 70°C. They are available in either ceramic or plastic packages.

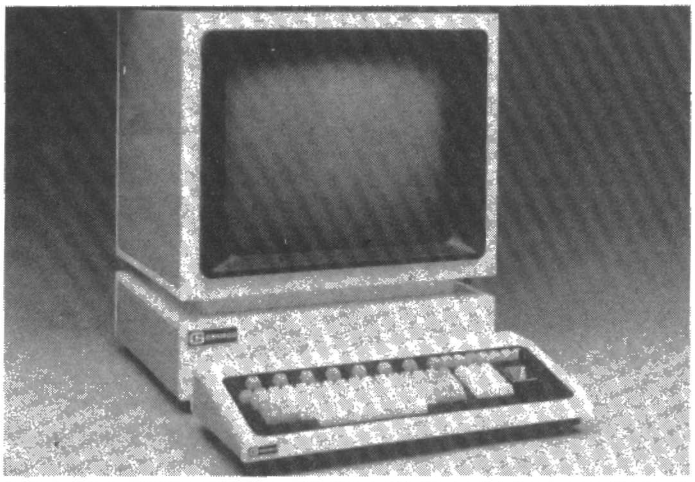
For further information:
Zilog (UK) Limited
Babbage House
King Street
Maidenhead
Berks SL6 1DU
Telephone: (0628) 36131
Telex: 848609

New Software Conversion Tools

Rapid Recall are now able to offer two new software conversion tools that will allow programs written for the Z80 and 6800 family of processors to be converted for use with the Intel 8086/8088 processors. Known as Zcon (for the Z80) and Mcon (for the 6800), the converters have been developed by Intel. Designed to run under Intel's powerful ISIS II operating system, both Zcon and Mcon assume that the source program is in Intel file format on floppy disc, and that either source is capable of being assembled without errors.

Interest for the new converters is expected to come from established Z80 or 6800 users who wish to use the 16-bit architecture of the 8086/88, without spending time and effort on software conversion.

For further information:
Rapid Recall Limited
Rapid House
Denmark Street
High Wycombe, Bucks.
Telephone: (0494) 26271
Telex: 837931



Lightweight Computing

A compact stand-alone microcomputer that occupies about the same desk area as a piece of foolscap paper has been introduced by Equinox Computers under the brand name "Episode".

"Episode" is a new lightweight computer powered by the Z80A microprocessor.

It is claimed that the machine will operate with virtually any VDU and printer, and can be used as one of the stations in a network linked to other equipment such as the Government approved Equinox 200.

Mobility is a prime asset. It weighs only 15lb, making it easy to transport and nudge aside to make desk space for other work.

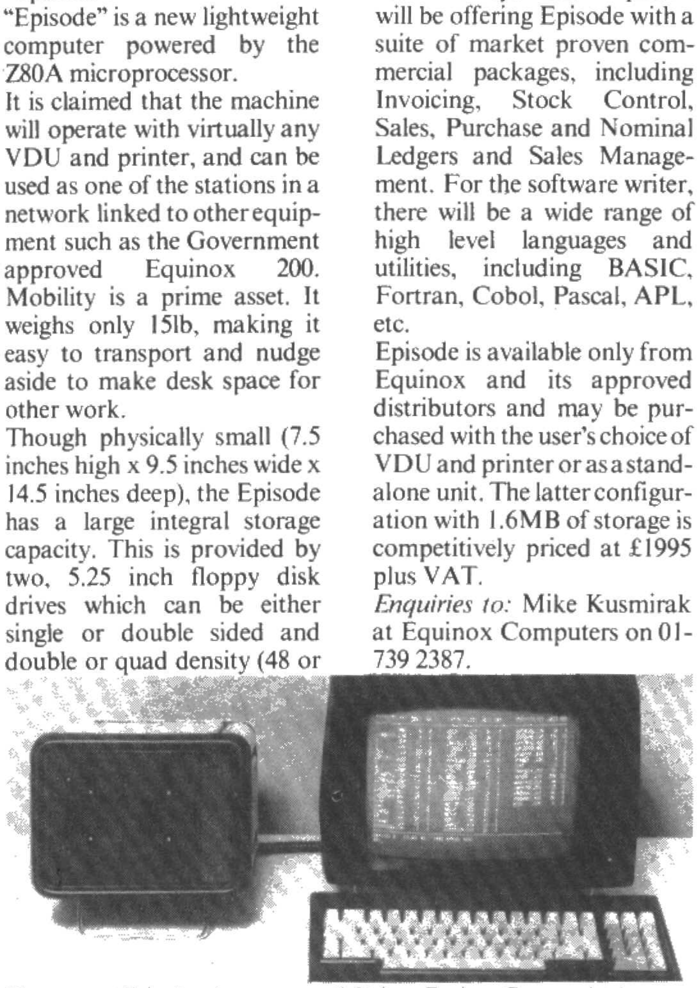
Though physically small (7.5 inches high x 9.5 inches wide x 14.5 inches deep), the Episode has a large integral storage capacity. This is provided by two, 5.25 inch floppy disk drives which can be either single or double sided and double or quad density (48 or 96 TPI), thus giving from 400KB to 1.6MB of unformatted storage.

Other features are two RS232C serial interfaces and a Centronics compatible parallel interface; a battery operated calendar clock, and 64K of dynamic RAM.

In addition to standard CP/M compatible word processing and information management software systems, Equinox will be offering Episode with a suite of market proven commercial packages, including Invoicing, Stock Control, Sales, Purchase and Nominal Ledgers and Sales Management. For the software writer, there will be a wide range of high level languages and utilities, including BASIC, Fortran, Cobol, Pascal, APL, etc.

Episode is available only from Equinox and its approved distributors and may be purchased with the user's choice of VDU and printer or as a standalone unit. The latter configuration with 1.6MB of storage is competitively priced at £1995 plus VAT.

Enquiries to: Mike Kusmirak at Equinox Computers on 01-739 2387.



The compact Episode microcomputer (left) from Equinox Computers takes up approximately the same desk space as a piece of foolscap paper.

New Low Cost Raster Graphics System

A high resolution, interactive, monochrome raster graphics system is now available from R & H Systems Limited of Wellingborough. The system, called G-1000, is designed for applications such as CAD/CAM, plot previewing, electrical engineering, scientific data analysis, mapping and circuit board design which require precise detail and data manipulation capability plus economy.

The Genisco G-1000 is the first low cost raster graphic display system to be based on the Z8001 segmented 16-bit microprocessor. This makes it plug-compatible with the Tektronix 4014-1 terminal and it is user programmable, offering up to 16K words of EPROM as well as 16K RAM.

The G-1000 is ideal for both OEM and end user applications. It can be up and running immediately with existing software.

The new Genisco terminal also offers the user the advantages of raster scan technology, as opposed to storage tube, which includes selective erase of any portion of the graphic or alphanumeric image. High contrast and brightness using a black and white screen permits clear viewing in normal light.

Resolution of the G-1000 is 1024 x 792 x 1 bit. It has a detachable keyboard with typewriter-style alpha-numeric keys, special function keys, a 12-key numeric pad and cursor controls for interactive capability.

In addition it incorporates an asynchronous serial interface which is RS232 compatible with data rates to 19.2K baud.

Product enquiries to be sent to: Peter Wright, R & H Systems Ltd, Oxford House, Oxford Street, Wellingborough, Northamptonshire NN8 4HG. Tel: 0933 227477.

The 128K EXPERT

A new 128K microcomputer, which Exleigh Business Machines have called the "Expert", has just arrived in the UK from Sord Computer Systems in Tokyo.

Based on the Z80A microprocessor, the "Expert" has a 128K byte internal memory, which is memory mapped. It has a monitor with a 12 inch screen and 2 x 320K disk drives. There are two RS232 ports and one parallel printer port. It also has a full ASCII keyboard.

For the standard package of the "Expert" the end-user price is £1950 which also includes, the CBASIC language and the new high level language called PIPS (Pan Information Processing System) which has been designed in Japan for the "Expert".

PIPS is said to be ideal for the non-programmer. It consists of about 100 commands for formating and entering the user's own data to suit his own particular requirements. The aim of PIPS is to bring computing skills to the average businessman who is without programming knowledge.

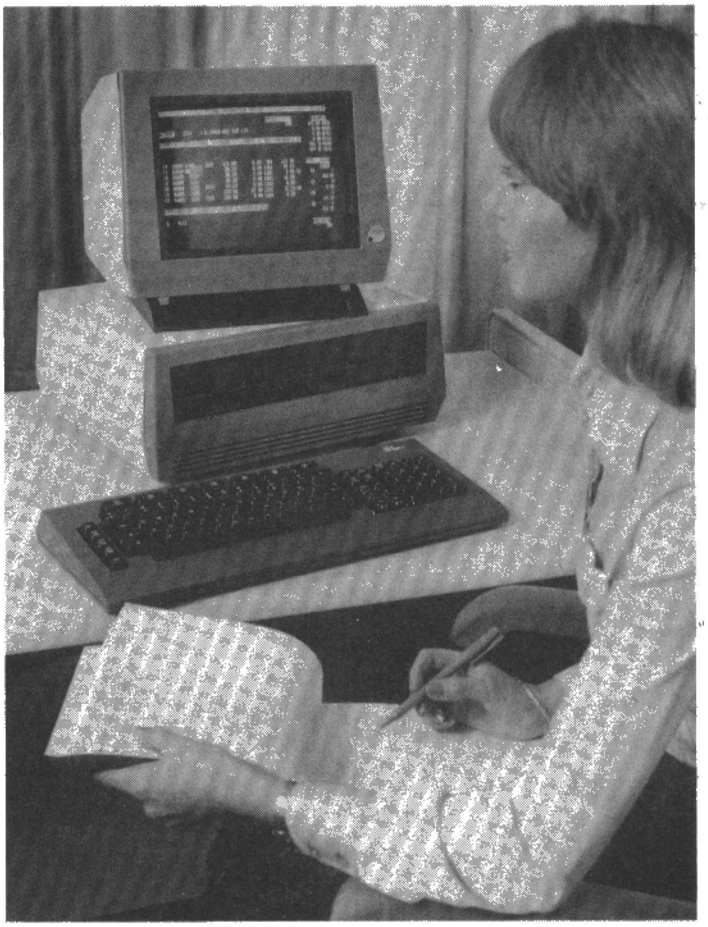
PIPS enables an operator to format and tabulate data, perform calculations and sorting routines with a single key instruction.

When a colour monitor is connected to the "Expert" PIPS can be displayed in the colour of the user's choice with varying backgrounds to identify specific information. The colour monitor costs £515.

The new PIPS language has achieved great acclaim in Japan and is expected to become popular in the UK.

For further information: contact Exleigh Business Machines Ltd., 11 Market Place, Penzance, Cornwall, Tel: 0736 66577.

The Sirius 16-bit Personal Computers



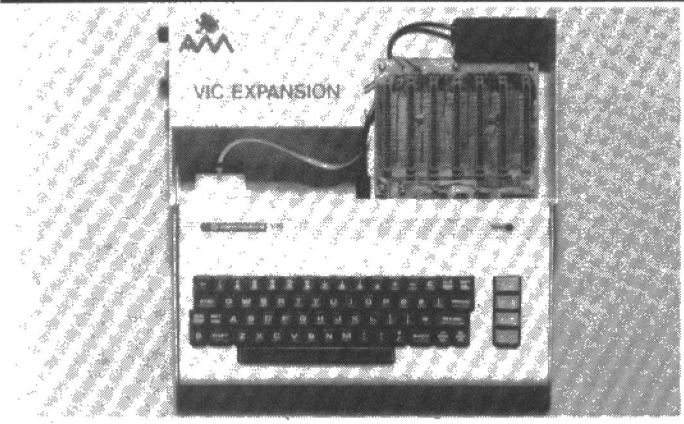
The ACT Sirius 1 is a third generation 16-bit personal computer specifically designed for business. At a price of £2,395 for the basic system which ACT claim is one of the best price/performance ratios available for a personal computer.

Developed by Chuck Peddle, formerly of Commodore and generally recognised as the father of personal computing, the ACT Sirius has 128 Kbytes semiconductor memory as standard, with plug-in modules taking it up to 512 Kbytes. It comes complete with a 1.2 Mbyte twin floppy drive, video monitor and detachable keyboard in an attractive ergonomic package.

It has a wide range of software and two operating systems, CP/M-86 and the IBM specified MSDOS open up a large library of existing applications programs. For software houses there is a wide choice of languages - compiled BASIC, COBOL, PASCAL, and FORTRAN. Microsoft's BASIC 80 is supplied as standard. In addition Micro-Modeller and Wordstar packages are available on the ACT Sirius along with ACT's own PULSAR accounting system.

ACT are the sole distributor of the Sirius in the UK and Eire. They will provide a field engineering service and maintain a comprehensive stock of parts. A network of 100 business system dealers will support the Sirius at a local and regional level. First deliveries of the Sirius to end users will be February.

For further information contact Chris Buckham 021 454 8585.



VIC 20 Expansion System

Arfon Microelectronics have not wasted any time in launching an expansion unit for the VIC 20. The unit comprises of a seven cartridge fully integrated system housed in an aluminium shell the same colour as the VIC. The system has its own power supply which will also meet the requirements of a printer being developed by Arfon, which it is hoped will retail for less than £100.

Memory cartridges are available with a choice of 3K (2 Eprom sockets) 8K or 16K RAM cartridges which will fit the VIC 20 alone or fit into the expansion board.

All the products described are approved by Commodore. The expansion system will retail for £85 plus VAT and the memory cartridges 3K-£26, 8K-£39, 16K-£65.

For further details:
Contact Arfon Microelectronics Ltd., Cibyn Industrial Estate, Caernarfon, Gwynedd, Wales.

Low Cost Daisy Wheel Printers

AMBAR Components Limited have just come to an agreement with Olivetti Peripheral Equipment (O.P.E.) to supply, from stock, a range of daisy wheel printers, floppy disc drives and hard disc (Winchester) drives.

Low cost daisy wheel printers, first patented in 1969 and produced in volume since 1975, have 13 inch or 17 inch platens, print bi-directionally at 20 or 30 characters per second in high quality word processor standard, and have Centronics or RS 232/V24 interface as standard. Other interface options are available. THE MODEL NUMBERS ARE DY 211 AND DY 311.

Floppy disc drives have been in mass production since 1974 and O.P.E. are recognised as a leader in this field with production running in excess of 50 thousand units per year. AMBAR are stocking 5¼" drives with soft or hard sectoring, single or double sided, single or double density 125 to 500K bytes, unformatted storage with standard ANSI/Shugart interface. THE MODEL NUMBERS ARE FD 501 AND FD 502.

Winchester-type fixed magnetic disc drives are available in two types, the first is a 5¼" with 7.5 megabytes storage and Seagate interace; the second type is a first for the U.K. and is available NOW from Ambar, a 5¼" Winchester with INTEGRAL TAPE BACK-UP, 12.3 megabytes storage and Multibus, LSI 11, S 100 interfacing. THE MODEL NUMBERS ARE HD 561 AND HDB 513.

Data and pricing information are available from Ambar Components Limited, at 0296 34141, Telex 837427.

COMPUTER INT
SLIDE PROJECT

Information is that which enables us to make decisions. It may take a variety of forms: numeric, textual, sonic and pictorial. The most familiar of these is probably numeric. As humans, our inability and dislike of handling this class of information was one of the prime motivations, many years ago, for the development of the digital electronic computer. Techniques for numeric information processing via computers are now well established. In many areas of application such as automatic process control, scientific analysis, simulation, and computer aided design/manufacture the prominent role of the computer is most apparent.

Over the last decade computer technology has turned its attention to yet another form of information — words and text. Advances in the power of both microcomputer systems and data storage techniques have been combined to produce a multitude of document, text and word processing systems. Like numeric computation, text handling is now a standard facility on most micros. By means of appropriate software packages it is possible to keep (and periodically update) address lists, compose essays or letters and analyse text for authorship and style.

Currently, there is "teeming" activity in yet a third area of information processing — graphics. Graphic information may take many different forms. Broadly, however, these fall into two fundamental categories — based upon either static or animated images. These may originate from two possible sources. Either they may be generated by a computer program or captured by some form of camera. Independently of their source these images may be stored on an appropriate storage medium and then retrieved for display via a suitable screen device. Presently, there is much interest in computer systems able to process pictorial information of this type — either internally (as in robot vision systems) or externally (as in image retrieval applications).

Graphic images may be stored externally on numerous types of storage device — for example, slides, cinefilm, videotape and optical disk. The first of these offers an easy, inexpensive way of storing static graphical images. The latter three media provide increasingly sophisticated image storage techniques that offer the possibility of handling both static and dynamically changing scenes. Combined with appropriate computer technology these external image storage devices have a variety of uses. Undoubtedly, slide projection equipment is the least costly and probably most readily available. In the remainder of this article we describe the use of a microcomputer for controlling the display of images retrieved from one or more slide projectors.

Use of Slide Projectors

Pictorial communication through the medium of slides is a powerful means of disseminating information. Because of the large amount of highly resolved detail that can be contained in a picture, this type of communication channel has a high bandwidth for information transfer. For this reason slides are often used to supplement lectures on scientific and technical topics. Other information dissemination activities such as computer aided learning and computer based aiding systems also frequently employ slide presentation techniques in order to supplement material presented via a VDU screen. In addition slides are often widely used for advertising and sales promotion — particularly when automated display systems can be set up and left running without a human operator.

Computer based training and aiding systems that involve the use of slide images will require a facility that enables the interconnection of their embedded microcomputer to the external picture projection equipment. In order to achieve this some form of hardware/software interface is required — as depicted in **Figure 1**. Microcomputer peripherals are usually interconnected by means of one of the internationally accepted interfacing standards. The most popular of these are the RS-232C, IEEE-488, CAMAC, S-100 and so on. Unfortunately, there are no commonly agreed upon standards for the interfacing of "exotic" peripherals such as slide projectors — video tapes or videodisks. In view of this arbitrary nonstandard interfaces often have to be used. The basic function of the interface is to convert control signals produced by the computer into a form that are acceptable to and which can be handled by the slide projector. Obviously, the detailed design of the interface will depend upon the nature of both the microsystem and the slide projector(s) to which it is to be interfaced.

Most modern slide projectors depend upon the use of some form of slide storage

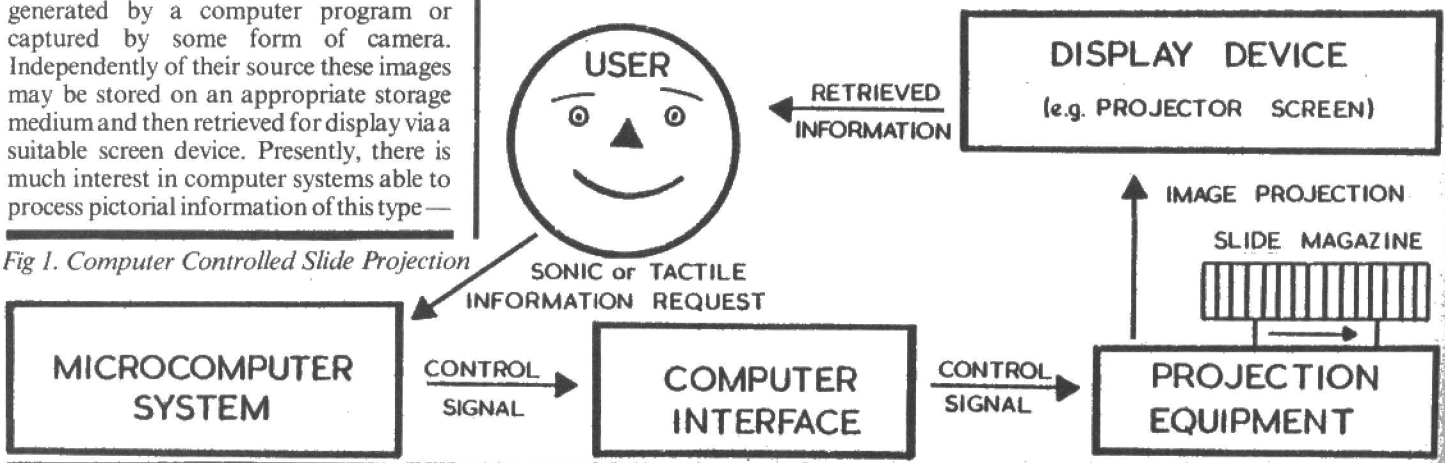


Fig 1. Computer Controlled Slide Projection

ERFACES FOR ORS

by Philip G. Barker

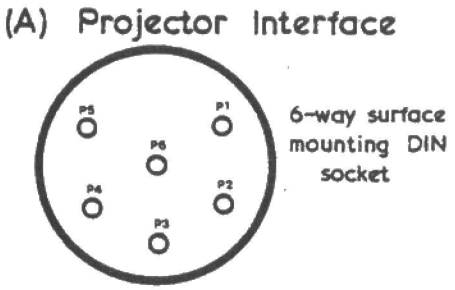
magazine. These are usually capable of holding from 50 to 100 images. The Kodak CAROUSEL S-AV2000, for example, can hold up to 80 slides in its circular magazine. Projectors of this kind will undoubtedly offer facilities that permit the use of a remote "hand-held" controller. Typically, this consists of a series of push-button switches mounted on a small keypad. The switches control the motion of the slide magazine (either forward or backward) and also provide a means of focussing. The wires running from the remote controller are cabled into the projector by means of a multiway plug that is inserted into a matching socket mounted on the projector.

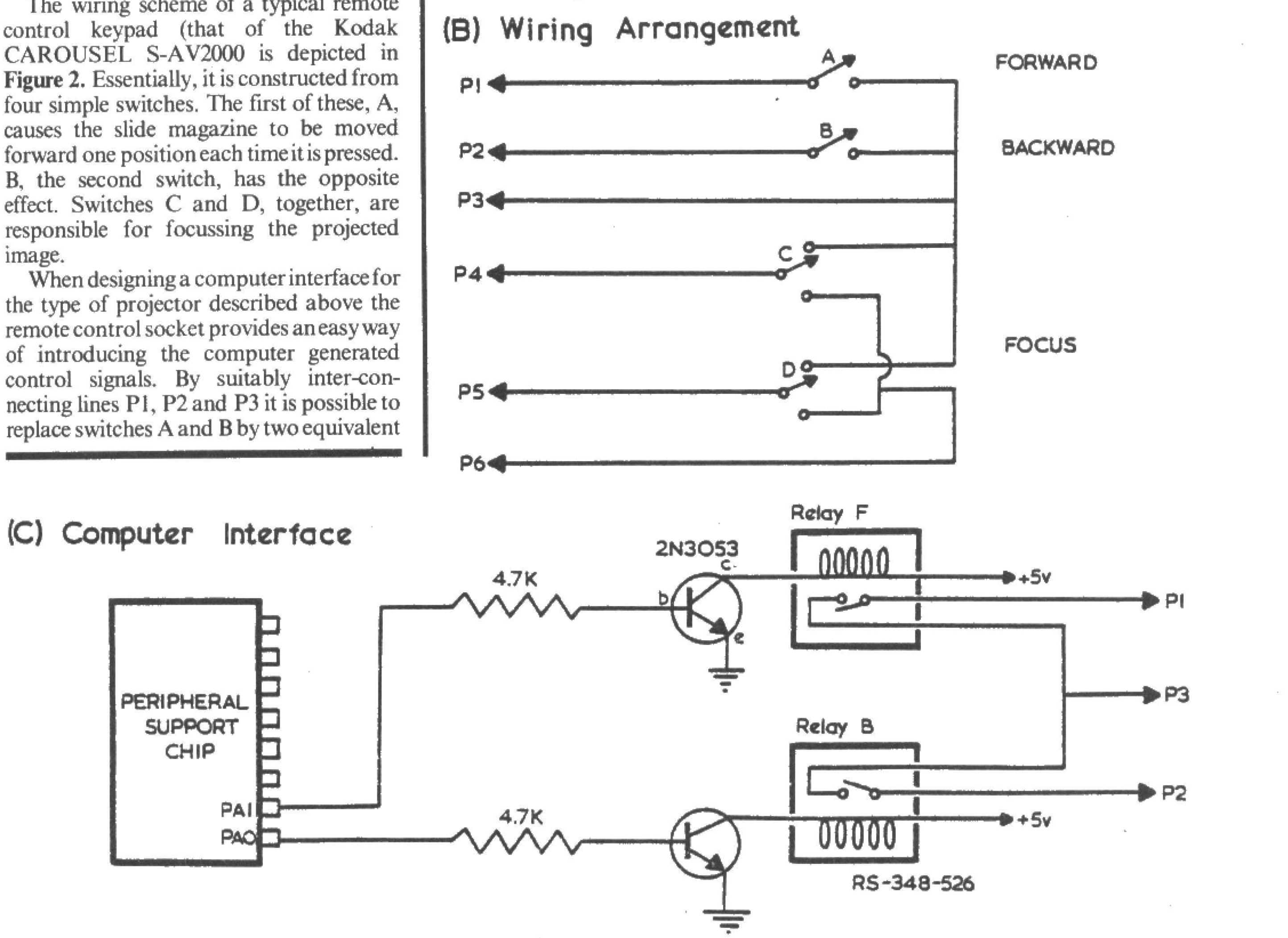
The wiring scheme of a typical remote control keypad (that of the Kodak CAROUSEL S-AV2000 is depicted in **Figure 2.** Essentially, it is constructed from four simple switches. The first of these, A, causes the slide magazine to be moved forward one position each time it is pressed. B, the second switch, has the opposite effect. Switches C and D, together, are responsible for focussing the projected image.

When designing a computer interface for the type of projector described above the remote control socket provides an easy way of introducing the computer generated control signals. By suitably inter-connecting lines P1, P2 and P3 it is possible to replace switches A and B by two equivalent computer controlled relay switches. Once this has been done it is a simple matter to operate these under software control via a suitable output port on the microcomputer. Most of these provide TTL signals that can be used to activate a transistor circuit that is designed to provide sufficient drive power to operate the external relay. Such a circuit is shown in the lower part of **Figure 2.**

Typical computer I/O ports may be based upon IC chips such as the INS8255N PIA, MOS 6522 VIA, MC6821P PIA or the Z80A P10 — depending upon the microcomputer system used. We have used a MOS technology 6522 VIA embedded in a PET host system to drive our relays. This provides 8 I/O lines that may thus be used to drive up to four slide projectors. ▶

Fig 2. Remote Controller for a Slide Projector





Sequential Projection

Based upon their repertoire of image retrieval strategies slide projectors may be categorised as belonging to one or other of two general classes. The first, and simplest, of these represents those projectors that are only able to operate in a sequential access mode. Projectors in the second class are more versatile. Members of this category are able to provide their user with the capability of randomly retrieving and displaying images. However, projectors of this type require a more sophisticated interface than that outlined above. In view of this, they will be discussed in more detail in the next section.

Controlling a single sequential projector by computer is a fairly straight-forward matter once the hardware interface has been constructed. Assuming that the interface connections are brought out through lines PA0 and PA1 of the PET User Port (see **Figure 2**) the program shown in figure 3A will enable a user to control the action of the projector. The PET keyboard is used as an input device. Typing the letter F causes the magazine to advance to the next slide while typing the letter B results in a backspace operation thereby enabling the previous slide to be viewed. Two control subroutines are provided. That at lines 300 through 380 is responsible for generating a pulse to activate relay F within the interface. The other, at lines 400 through 480 generates a pulse to activate relay B. This program and interface have been extensively used to control a Kodak S-AV2000 projector.

The major limitation of a simple single projector configuration lies in its small storage capacity — 80 slides. The system could be expanded to handle 320 images by attaching a further three projectors. However, for many applications this too may be insufficient. Storage limitations of this type can easily be overcome by modifying the interface circuit in such a way that it expands the I/O capability of the User Port. A suitable modification is shown in figure 4. It is based on the use of eight SN74LS175 quad storage latches (D-type flip-flops) and a SN74LS138 3-to-8 decoder/demultiplexer chip. The latter is used to generate latch enable signals. User Port utilisation is as follows: PA0, PA1 and PA2 are used as a simple 3-bit address bus that specifies which latch (and hence, projector) is to be enabled: each latch services two projectors. Pins PA4, PA5, PA6 and PA7 act as a simple four-bit data bus whose contents are used to update the enabled latch. The CS2 line is used to produce a clock pulse which causes the selected latch to be updated on its low to high transition.

Using this circuit up to sixteen projectors can now be controlled thereby providing a capacity for as many as 1280 slides. The control program for such an arrangement is shown in figure 3B. The user enters the projector number (in the range 1 through 16) and, as before, the required direction of magazine rotation — F or B. Notice that the interface arrangement shown in **Figure 4** provides the ability to project up to sixteen images simultaneously. By means of more sophisticated programming techniques it becomes feasible to produce a variety of interesting graphic effects by super-imposing several different images. For example, it would be possible to build up complex pictures from much simpler ones or decompose compound scenes into their component parts. Techniques such as this offer valuable tools for computer based training and aiding applications.

Random Projection

Sequential presentation of images is a useful techinque when the information to be displayed is highly ordered and no departures from a linear access scheme are

Fig 4. Hardware Interface for Controlling 16 Projectors

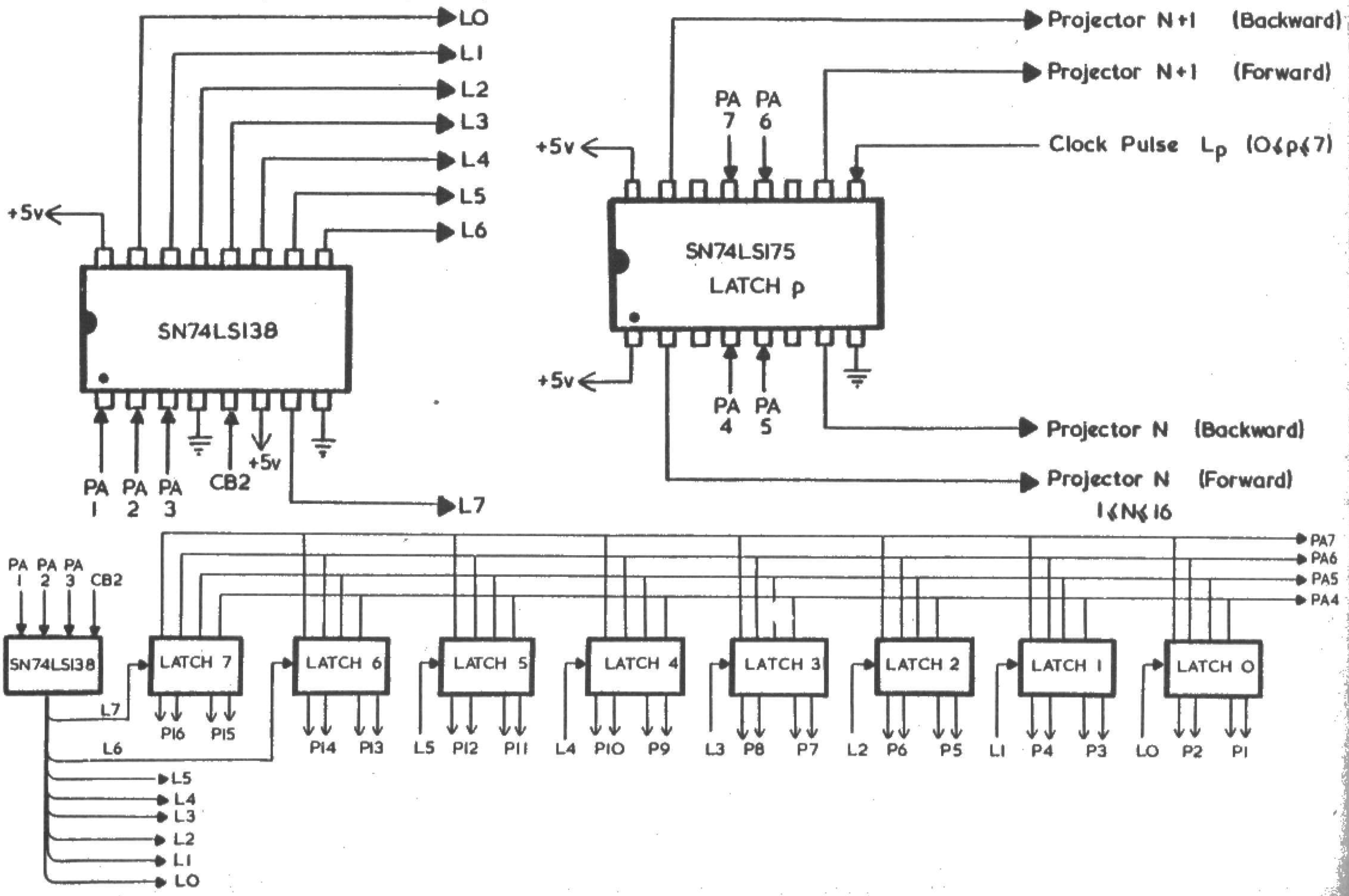


Figure 3 Control Programs for Sequential Slide Projectors

(A) Single Projector

```
100 POKE 59459,3
110 POKE 59471,0
120 PRINT "□↓↓↓ SEQUENTIAL SLIDE
      PROJECTION"
130 PRINT "↓↓ —F ADVANCES MAGAZINE"
140 PRINT "↓ —B SHOWS PREVIOUS SLIDE"
150 REM GET USER'S REQUIREMENT
160 GET A$: IF A$ = "" THEN 160
170 IF A$ = "F" OR A$ = "B" THEN 190
180 GOTO 160
190 IF A$ = "F" THEN GOSUB 300
200 IF A$ = "B" THEN GOSUB 400
210 GOSUB 160
300 REM MOVE MAGAZINE FORWARD
310 X = PEEK (59471)
320 X = X OR 1
330 POKE 59471,X
340 K = TI
350 IF TI < K + 20 THEN 350
360 X = X AND NOT 1
370 POKE 59471, X
380 RETURN
400 REM MOVE MAGAZINE BACKWARD
410 X = PEEK (59471)
420 X = X OR 2
430 POKE 59471,X
440 K = TI
450 IF TI < K + 20 THEN 450
460 X = X AND NOT 2
470 POKE 59471,X
480 RETURN
```

required. However, there are many situations where this mode of usage is not applicable. In many real-time image retrieval systems, for example, it is never possible to anticipate (with any certainty) the order in which images will need to be displayed. As an example of this, consider the use of image projection as a means of augmenting the learning processes involved in computer based training systems.

Suppose someone is to be trained in the use of microelectronics. Typically, under computer control a slide projector might be used to show a trainee some slides containing pictures of electronic components and circuit diagrams in which these are used. Then, the computer would attempt to assess the trainee's understanding of the material by requesting the answer to a multiple choice question that it displays on its VDU screen. Assume that this has six single valued response options — say A, B, C, D, E and F. Once the student has responded to the question the computer may be required to execute the following type of decision logic:

If reply is A then show slide N;
If reply is E or C or B then show slide K;
If reply is D or F then show slide P;
If HELP requested then go to HELPER;
Go to INVALID-REPLY routine;

Obviously, to implement this kind of image presentation strategy in an effective way a random access slide projector is a necessary pre-requisite.

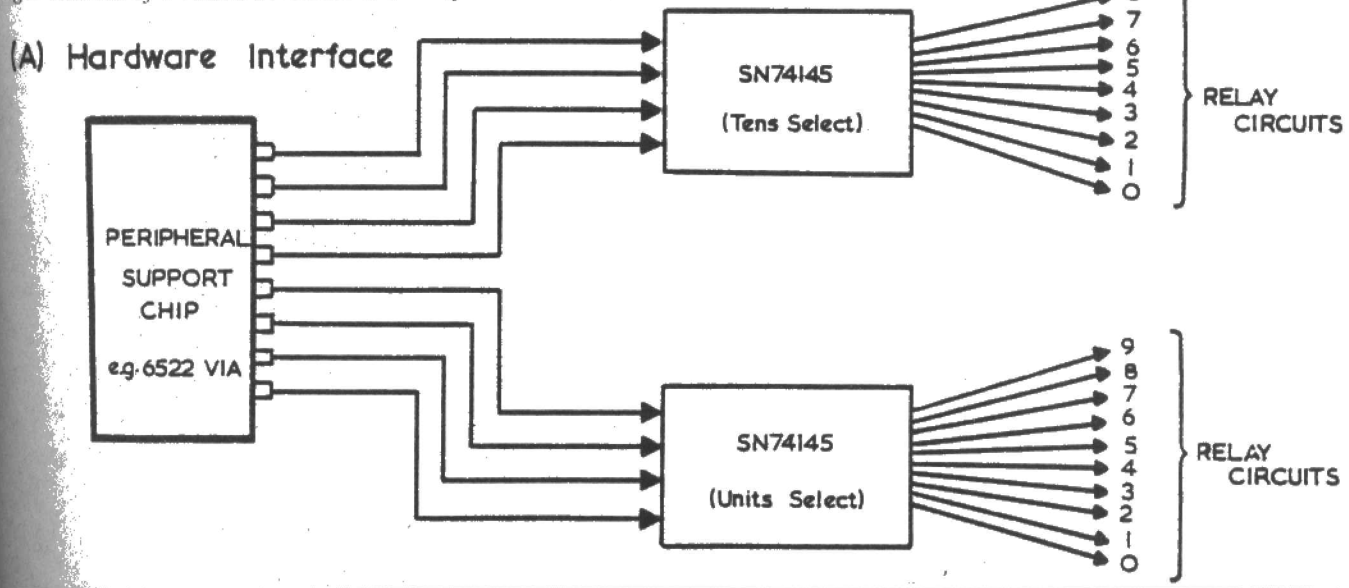
Commercial projectors of this type, such as the Kodak CAROUSEL S-RA2000, are usually fitted with numeric keypads. These enable their user to "key-in" the decimal number of the slide that is to be retrieved and displayed. This number represents the actual sequential position of the slide in the storage magazine. Once it has been keyed-in the projector rapidly retrieves the slide and projects it. The time to retrieve an image is less than five seconds — no matter where it resides within the magazine. Thus, with this type of projection equipment any sequence of slides can be rapidly displayed without the need to physically re-position them — as would be necessary in the case of a sequential projector. Unfortunately, however, the design and construction of computer interfaces for random access projectors is more difficult since they place a greater demand on the I/O port of the host microcomputer — as will be described below.

The way in which the remote decimal keypad controller of the Kodak RA projector operates is fairly easy to understand. It may be likened to two banks of switches — A and B. Bank A, consisting of nine switches, selects the "tens digit" of the slide number, bank B, containing ten switches, then selects the "units digit". The slide to be retrieved can now be specified by closing just two switches, one in bank A (range 0 to 8) and one in bank B (range 0 to 9). This logic is fairly easy to emulate through the use of two SN74145 BCD-to-Decimal decoder chips as shown in **Figure 5A**. The relay circuits used are similar to▶

(B) Software for Interface Control

```
10  POKE 59459,255
20  INPUT "□○↓↓↓↓↓ENTER SLIDE NUMBER"; NS
30  IF NS>80 THEN 90
40  IF NS<0  THEN 90
50  K=INT(NS/10)*16+NS-INT(NS/10)*10
60  POKE 59471,K
70  GOTO 20
90  PRINT "↓↓INVALID SLIDE NUMBER SELECTED"
100 PRINT "TRY AGAIN"
105 K2=TI
106 IF TI<K2+120 THEN 106
110 GOTO 20
```

Fig 5. Control of a Random Access Slide Projector



those employed in the case of the sequential projector shown in **Figure 2.** Notice that each SN74145 IC requires four input lines. Together they require the use of all eight I/O lines of the microcomputer output port. This is a severe limitation if other devices also need to use this for I/O. However, as will be described later, it is a fairly easy matter to overcome this limitation.

A simple control program to operate the random access slide projector is shown in **Figure 5B**. Its logic is quite straightforward. The slide number typed in by the user is transformed from decimal to two BCD digits. The resultant bit pattern is then sent out via the Pet User Port to the pair of decoder chips housed in the interface. These then activate appropriate relay circuits which now emulate the effect of the normal remote numeric keypad controller. The projector retrieves the specified image and displays it.

A more sophisticated application of the projector is embodied in the program listed in **Figure 6**. This software enables it to be programmed to show any sequence of slides over and over again — as many times as its user requires. The time for which any particular slide image is displayed can be set to a default value or uniquely specified. This system has been used for a variety of automated demonstrations and advertising applications.

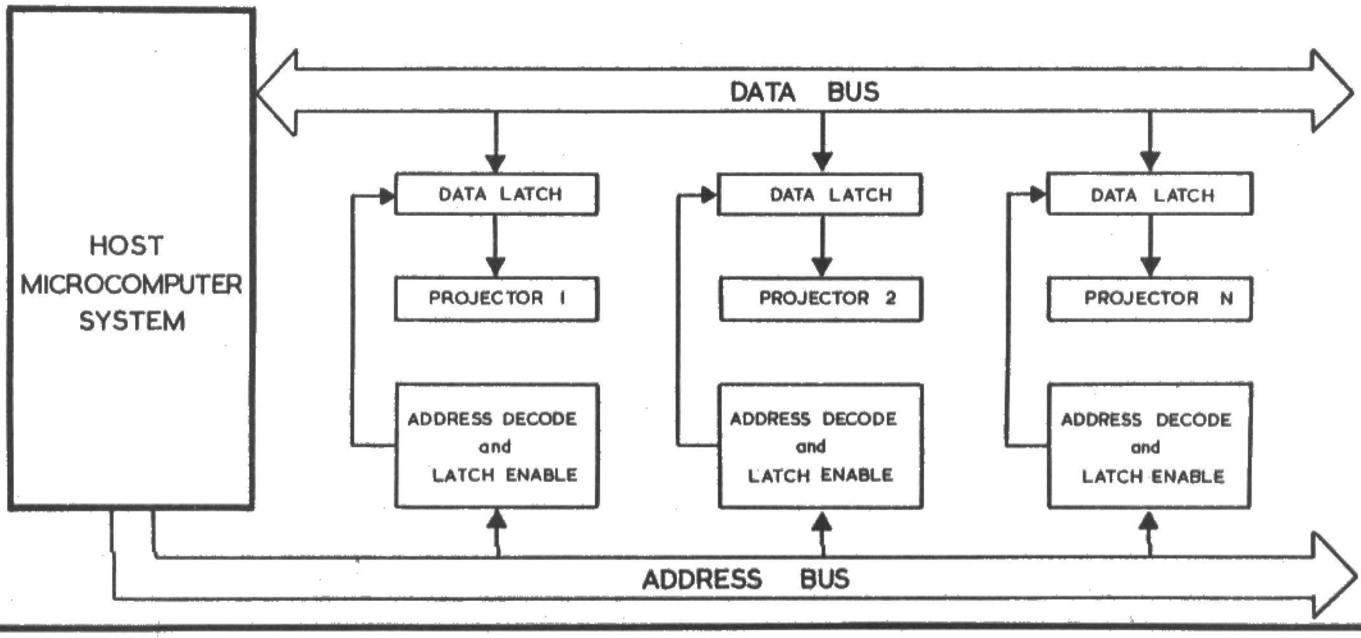
Should the need arise to control a significant number of random access projectors then, because of the limitation mentioned above, an alternative addressing scheme needs to be found. The User Port cannot be used because this is dedicated to the transfer of switch selection data. The microcomputer address bus provides one solution to this problem. By equipping each projector with an address decoder/latch enable circuit it becomes possible to memory map the projectors onto the address space of the computer. Then, the User Port can be used as a common data bus from which the data is strobed by the projector whose identification is sent over the address bus. If the User Port is not available (because it is being employed to control other devices) the PET's bi-directional data bus could be used to transmit the slide selection data. This arrangement is shown schematically in **Figure** 7. When using this approach to projector control, the BASIC statement POKE X,Y could be used to request that slide Y be displayed on the projector whose address is X. Memory mapping of projectors onto unused ROM addresses within the PET can thus be used to provide sufficient expansion capability to support any reasonable number of slide projectors without placing any demands on the User Port. An analogous strategy could be used to control the sequential projectors described in the previous section.

CONTINUED ON PAGE 34

FIG 3 **(B) Multiple Projectors**

```
100 REM CONTROL OF MULTIPLE SLIDE
    PROJECTORS
110 REM ****************************
120 REM
130 GOSUB 390 : REM INITIALISE SYSTEM
140 INPUT "□ ↓↓ PROJECTOR NUMBER";N
150 IF N < 1 OR N > 16 THEN 140
160 INPUT "↓↓FORWARD OR BACKWARD"; D$
170 IF D$ = "F" OR D$ = "B" THEN 200
180 PRINT "↑↑↑";
190 POKE 32989,32 : GOTO 160
200 REM CALCULATE WHICH LATCH TO USE
210 L = INT ( (N-1)/2)
220 REM NOW CALCULATE DATA VALUE
230 REM ASSUME FORWARD MOTION
240 V = 1
250 IF D$ = "B" THEN V = 2
260 REM SEE IF EVEN OR ODD PROJECTOR
    NUMBER
270 REM ASSUME ODD TO START
280 SF = 1
290 IF N = INT(N/2)*2 THEN SF = 4
300 REM CALCULATE VALUE OF DATA WORD
310 V = V*SF
320 REM SEND PULSE TO PROJECTOR
330 GOSUB 490
340 K = TI
350 IF TI < K + 20 THEN 350
360 V = 0
370 GOSUB 490
380 GOTO 140
390 REM ***INITIALISE SYSTEM
400 POKE 59459,255
410 X = PEEK (59468)
420 X = X OR 128 OR 64 OR 32
430 POKE 59468,X
440 FOR L = 0 TO 7
450 V = 0 : REM CLEAR LATCHES
460 GOSUB 490
470 NEXT I
480 RETURN
490 REM ***UPDATE OUTPUT LATCH
500 D = V*16 + L
510 POKE 59471,D
520 POKE 59468,(PEEK(59468) AND NOT 32)
530 POKE 59468,(PEEK(59468) OR 32)
540 RETURN
```

Fig 7. Memory Mapped Random Access Slide Projector



VIDEO GENIE WITH 2K EPROM

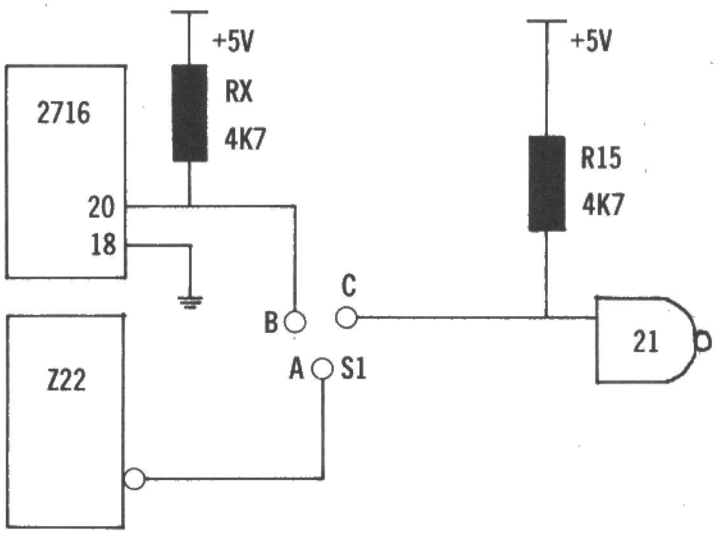
by Jay Lazzari

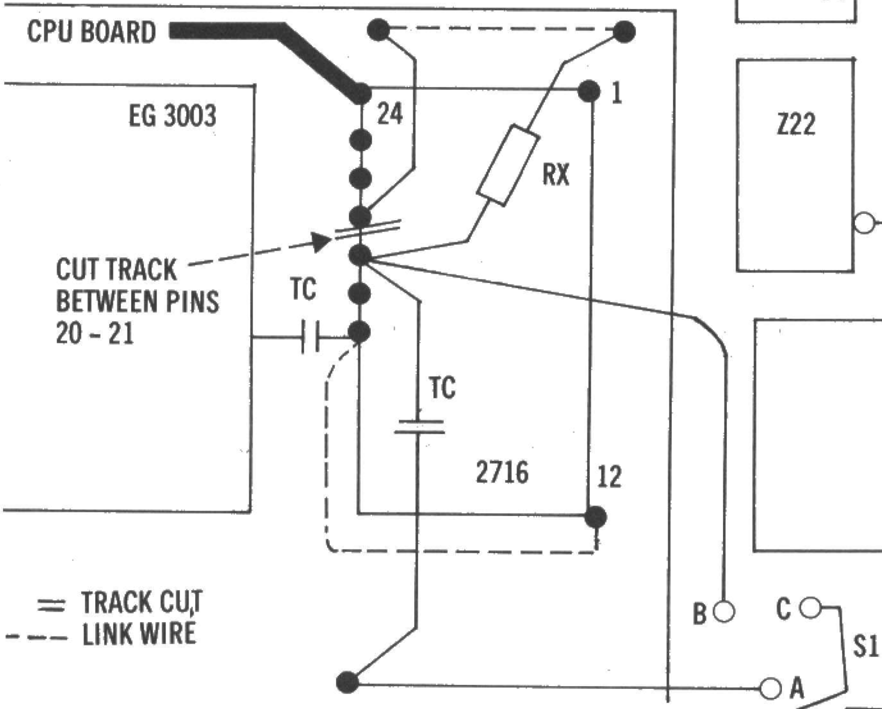
After eventually deciding to "take the lid off" my Video Genie EG 3003, I then did the standard "mods" of putting in an audio amp and changing the shift key for a clear and tab key. As I use Microsoft's Editor Assembler (Tape Version) I find the tab key essential when running this programme. The only way of saving an object code was on tape, this works fine but was quite laborious when loading a programme I have that prints data off the screen to my Teletype (110 boards).

"How nice it would be to have this programme in Eprom," I thought. Looking at the C.P.U. board there just happens to be an expansion area for a 24 pin device. This device is addressed at 3000-37FFH not used by my Video Genie at present except for a few addresses for a disc-based system.

Fitting a 24 pin chip base, a few track cuts, a resistor and toggle switch will allow 2K of Eprom at 3000h to be enabled when required.

The only drawback with this system is that one has to be able to programme Eprom's. As I own a modified Softy, I can programme single rail Eprom's with ease. I think the Softy kit is well worth the expense of using machine code with the system I use on the Video Genie.

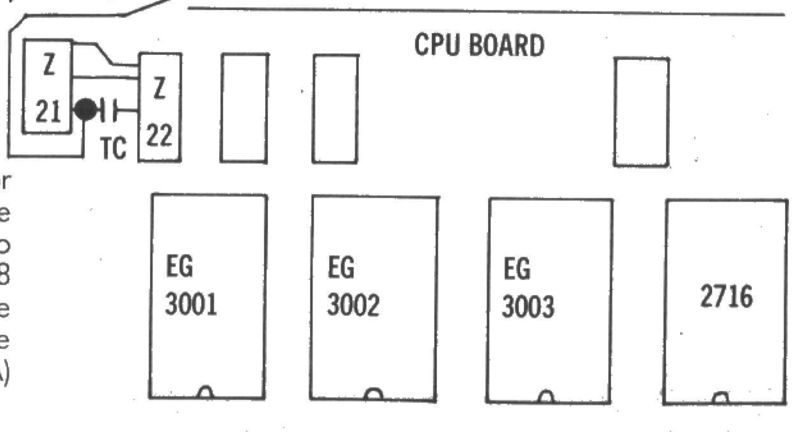




VIEW FROM FOIL SIDE ▲▲

MOUNT S1 BY DRILLING HOLE IN THE FRONT LOWER HALF OF THE VIDEO GENIE CASE.
S1 IS A SPDT SWITCH
RX IS A 4K7 ¼ WATT

VIEW FROM COMPONENT SIDE ▼▼



Using the Eprom

As I mentioned earlier, I have a utility programme for printing the contents off the screen. Lets suppose the programme started at 3000H, all you would have to do to run it is - type "system hit newline, then type /12288 (3000H in decimal) hit newline. Don't forget to enable the device first by throwing the toggle switch to the enable position (B). The switch (SI) is best left in (A) position on switch on.

MEMORY AN INSIDE JOB

by Ian Sinclair

When I first bought my TRS-80, 16K seemed to be a very large amount of memory. At that time, 16K on the TRS-80 cost a lot less than 8K on anything else, and it was then, and is even now, among the larger amount of free memory offered in a single box. For a lot of purposes, 16K was more than adequate, and coupled later with a Stringy-Floppy for mass storage, and a serial printer driven from the cassette port, 16K remained perfectly adequate for all my needs for a couple of years. Things only changed when I started to use the excellent Word Processing routine, the Electric Pencil, to a greater extent. Using 16K along with Electric Pencil leaves room for only about 2000 words of text, which is less than half the length of the average book chapter. There was, of course, no objection to recording the text (using cassette) in sections, but printing it was a nuisance, requiring the printer to be stopped at the right places so that a new load of text could be loaded in without spoiling the layout of a page.

Mysterious Reboots

At first, none of this tempted me to expand, because the "official" Tandy expansion involved buying another box which would cost as much as the computer did, and which had, like a well-known pill, some undesirable side effects, like losing your program when the RESET button was pressed. Friends who had expanded in this way also complained that they got mysterious reboots, returning to the switch-on procedure, along with loss of program. This was always attributed to the use of edge connectors which were solder-coated rather than gold-plated. My 16K machine was quite incredibly reliable, including the cassette operations, so that I resisted the temptation to expand.

This year, however, with five books in the form of cassette tape to print, and not so much time to spare, the possibility of expansion again loomed up. By this time, the expansion interfaces were no longer available, because the Model 1 had been out of production in the U.S.A. for a year. This wasn't such a great worry, because I had ordered a new BBC Microcomputer by that time anyway, but I still needed the TRS-80 to print out the material on cassette, as it might take me some time to devise a program to allow the BBC Micro to read and use Electric Pencil tapes. A series of adverts in the U.S. magazines, however, drew my attention to the possibility of internal expansion boards.

Internal expansion is an attractive proposition. It means using a board packed with 4116 RAM, plus one address decoding chip, sitting on the sockets of the original RAM. I knew that Video Genie owners had discovered that they could expand the Genie to 32K simply by "piggy-backing" RAM chips on top of the original ones, and the idea of using a better-engineered version appealed to me. Dynamic RAM like the 4116 does not take much operating power, and the unit was neat enough to fit inside the keyboard, eliminating the problems of these dodgy edge connectors. At 80 dollars for an expansion up to 48K, I decided that it was a risk I had to try. This was in late July. I rang up the manufacturers, Holmes Engineering of Salt Lake City, Utah, and ordered the 48K unit.

By September, there was no trace of delivery, but another phone call brought me reassurance that the unit was on its ways. In November, with still no sign that anything was happening, I cancelled by letter, only to find a few days later that the unit was waiting for me in the local Post Office, together with a bill for £11.56 in Customs and V.A.T. There didn't seem much point in returning it by then!

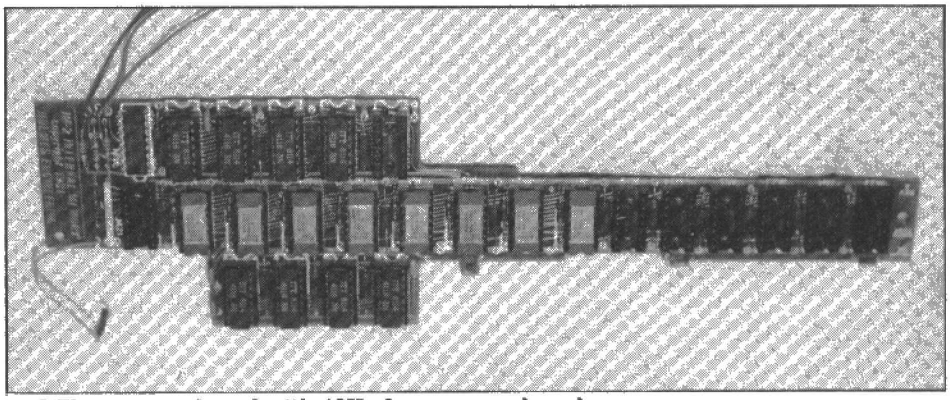


Fig 1 The memory board with 48K of memory on board

The unit is well constructed, and well thought out. Installation sounds easy, but requires some nerve and a certain amount of brute force. To start with, the TRS-80 keyboard has to be opened up. This invalidates the guarantee, but the guarantee is usually up by the time you take it out of the shop anyhow, and mine was well and truly up. My TRS-80 was purchased at a time when it was an almost unknown computer here, and it was a Compshop special, having started life as a 4K unit, and fitted with 16K over here. This meant that the seals were broken anyhow, and since I had earlier fitted the lower-case modification for the Electric Pencil, I felt that there wasn't much point in being queasy now.

Lumps of Solder

The installation of the additional RAM means removing the 8 4116 chips from the keyboard, and placing them in labelled positions in the new boards, along with another 32K (16 × 4116). I found some of the original 4116's mounted at crazy angles in their sockets, because of lumps of solder on the pins, which made me wonder where they had come from. I removed the solder, and plugged them into the new board. The instructions then call for four flying leads to be clipped to IC pins (one to a resistor) to give the decoding signals, and then the memory board, which is fitted with pins underneath, is plugged into the now-empty RAM sockets of the TRS-80.

Putting it back

Quite a lot of force is needed to push the pins of the memory board into the empty RAM sockets, and it isn't easy to support the main TRS-80 board so that this force can be exerted without damaging something. My first attempts were a disaster. The computer came on normally, indicating the presence of the full 48K of memory, but refused to run any programs. A memory test did not report any faulty memory, but dropped out with faults in non-existing lines, indicating that there was an address fault. Most programs simply landed back to the MEMORY SIZE? switch-on question when RUN.

Putting it all back as it had been did not cure matters, and a very close inspection of the main board revealed two possible causes. One was a capacitor lead which was perilously close to an address line, and might have been touching, the other was in the form of four sticky foam pads which were supplied with the board to help hold the clip leads in place. All of these pads were stuck across tracks on the board, and therefore a cause of potential trouble. Removing the pads and easing up the capacitor lead, a victim of the board insertion procedure, restored normal operation as far as I could tell.

I installed the board again, this time soldering the four flying leads in place instead of clipping them, and this time was rewarded with what looked like normal operation, despite problems caused by earlier modifications — the lower-case attachment wires had pulled some of the track off the board, causing problems with the video display. With this sorted out, a memory check program ran through all 48K with no faults reported, and no hang-ups. I began to feel that perhaps it had been worth while.

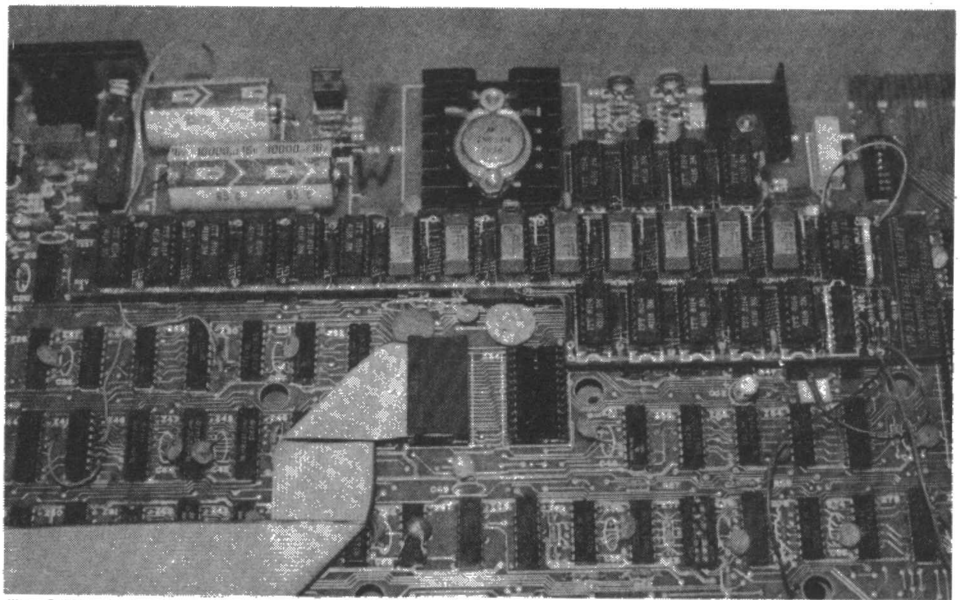


Fig 2 The board in place on the TRS80 main board.

My rejoicing was premature, however. The Electric Pencil soon found some new faults when I tried to use it. The program loaded perfectly, but then froze up when I tried to use it. and none of the keys had any action. After reloading and typing a thousand words, I lost the lot when it abruptly returned to its MEMORY SIZE? switch-on procedure. It looked as if I had exchanged a reliable 16K unit for a very unreliable 48K one.

I started trying remedies. The first thought was that that the power supply was overloaded. The test was to take 32K of memory out, and try again. Same problem — totally unreliable. Next obvious step was to take the memory board out and try again. This seemed to stop the problems, and I got a mornings work done, then sent the memory board back.

Unfortunately, my troubles were not over. The TRS-80 became more and more unreliable, and every attempt I made to cure it made it worse. I ended up selling it for scrap.

So there it is. A memory of 48K for only £50 or so looks very attractive, but you have to be prepared for problems. Lets face it, if someone like me who has lived with the smell of hot solder for 30 years can be caught out, then you too might just wreck a good computer as well. In particular, you must be prepared to handle the fragile TRS-80 board with very great care, and to inspect everything after installing the board. While I was waiting for delivery of the expansion board from the U.S., several firms in the U.K. started to advertise dynamic RAM expansion boards, and if I had not already had the board on order, I would have been very tempted to use a locally-made product. If you have problems, its always more comforting to know that the manufacturer is only a few hundred miles away rather than a few thousand.

Traumatic experience

Scrapping a computer has been a traumatic experience, and it has convinced me that a computer design which is arranged to make expansion easy, with the minimum of handling of the boards, will always be a better buy than one which needs modification. This approach is reflected in all the newer designs, like the TRS-80 Model III, and the BBC Microcomputer. It is also the reason why so many educational authorities have plumped for the RML 380-Z — its ability to expand by simply plugging in more boards makes up for the high initial price, and the price of the RML-380Z with 48K and twin double-sided discs compares very famourably with the price of the Model III TRS-80. Another point in favour of the 380Z is that all connections from the main computer are made through robust Cannon-type plugs and sockets, rather than through fragile edge connectors with unreliable contacts.

As a tailpiece, I have just seen the U.S. expansion board for the TRS-80 advertised from some dealers in the U.K., at only twice the price I paid. Perhaps at that price, they can fit the board and guarantee their workmanship for a year. I, for one, won't look at "add-ons" unless I can have that sort of guarantee that I will have a reliable computer afterwards.

COMPUTER AIDED DESIGN

by
Ralph Lovelock

This is the first part in a nine part series on computer-aided-design.
We hope that during the next few months readers who follow the series will become well equipped to design their own electronic circuits using a personal computer. The computer used by the author for the series is the ZX81 with the 16K memory extension. The whole series should comprise of the following parts subject to changes later:

1. *Introduction of CAD.*
2. *Assembly by matrices.*
3. *From two terminal impedances to two part matrices. (Algorithms).*
4. *Balanced bridged, and twin tee filters. (Algorithms).*
5. *Transformers and Lines. (Algorithms).*
6. *Overall logic of control program. (Including the program itself).*
7. *Inputting the individual component values. (Including sub-routine program).*
8. *Outputting overall results and de-bugging tests. (Including programs).*
9. *Operating instructions, Interpretation of results, etc.*

There will be some complex arithmetic in part 3, equivalent circuits and matrix type conversions in part 4 and some transmission problems in part 5.
Details of mathematical derivations will be included separately for those readers whose maths does not stop at 6th form, but detailed mathematical discussions are avoided in the text.
While this is the most ambitious project we hve undertaken for the ZX81 it should provide this low cost machine with a new type of status and it will rapidly be regarded as a quite serious design tool.
While some of the maths is quite heavy later in the series we feel it would not be right to water this important feature down and indeed talk down to readers - best of luck - Ed.

It is hoped that this article may be the first of a series dealing with the present continuing development of an ambitious CAD suite of programs on a ZX81 with 16K and printer. In the future it is hoped to develop (or obtain from Sinclair if they make it available) a second 16K extension to increase the scope of the present project; the addressing is already available within the machine, and the type of extension connector used to add the printer should serve also to add a further memory bank, but, of course a second power unit will be necessary to drive it.

The reader is warned that the series of programs to be described are written for the ZX81; the Basic of this machine has a number of features non-standard on any other, but the coding of the Basic and of the keyboard make it much faster to key long programs, and the editing facilities are excellent and make development and de-bugging easy.

With a long program such as the final suite under development, it is impossible to key and debug the whole thing, even if a day exceeding 14 hours could be worked with mind still alert, a 'glitch' on the mains, lasting only a few milli-seconds, suffices to remove several hours of work from the RAM. Sections of the program are keyed, and when more than a hundred lines are in, the whole is run onto tape. At a later time, it can be put back in a few minutes, edited to remove problems, a further section added, and the whole then recorded again. During development, a single C12 cassette has been used, recording first on one side, and then on the other, switching backwards and forwards so that if for any reason (no single instance has yet arisen), the new recording proves faulty and fails to load, only the most recent additions are lost, and the original is still available on the other track.

The present project is written in sections, each one terminated in a 'RETURN' so that only those necessary need be used, economising in memory and easing considerably the problems of development and de-bugging. Given a design of circuit and values, it is simple on a computer to evaluate the exact performance, but it is virtually impossible to start from a desired characteristic and calculate the exact values of practicable components to produce it. Most existing designs can only be calculated from scratch for 'ideal' components with zero dissipation, and the existant 'strays' and losses give a considerable departure from the theoretical values in the neighbourhood of the many resonances usually involved.

It is only the immense amount of work which can be accomplished in a small time that enables an alternative method to be used in these cases, when a computer is employed. The method involves 'iteration', the zero-dissipation designs already published are used to feed initial values, along with practical values of dissipation, into the machine, and record on a printer the exact characteristic resulting; the program is so written that without disturbing the main values, a small change may be made where experience shows an improvement may be expected, and the resulting characteristic run again. This method of slowly adjusting one value at a time and noting the results, will eventually lead to a set of optimum values and a reliable forecast of performance.

For anyone not familiar with the method, the following short and useless program can be run and the efficacy of the method noted step-by-step. It is a very inefficient method of calculating a square-root, and is only presented to give a visual example of the principal of iteration.

```
10. PRINT "input X / 1"
20. INPUT X
30. LET W = X/2
40. LET Y  = W**2
50. PRINT W; "= SQR"; Y, X
60. STOP
70. LET W = W + (X-Y)/2
80. GOTO 40
```

Initiation by keying 'RUN 10' will give an invitation to input a value greater than unity, and then wait for the value to be entered. Entering it, and keying NEWLINE will give a first estimate of the square root of the number keyed, together with the square of the estimate and the number keyed. Keying CONT and pressing NEWLINE will then give an improved estimate. Continuing keying will give a steadily closer approach which alternates from side to side of the exact value. The process may be continued until the difference displayed on the screen is as close as may be desired.

This first article is being written so that the editor may decide whether he is interested in continuing the series, so that instead of spending space on discussion of the method adopted to evaluate complicated circuit performance, and which may not come to publication, a useful section of the suite will be given, employing no very original methods, but being a series of short sub-routines, which may prove useful in ▶

any attempt to calculate circuit performance, since all such will employ complex arithmetic which is performed by this program.

Most elementary manuals recommend using the REM statement prolifically to enable the logic of the program to be followed readily, but this entails a very wasteful use of expensive memory; the form presented here dispenses with this luxury, and annotates the printed version of the programme, which is the place where one looks for enlightenment, and where the explanations can be phrased in a wider symbology than is available on the normal home computer. There is nothing original in this program, but a few points are worth noting for the help of those new to programming.

The values of the 'complex' expressions are contained in two arrays, A for the real component and B for the imaginary one. For ease of menomonics when writing programs which utilise these routines, the entry indices are constant as C for the first expression, and D for the second; E is invariably used for the one output. This principle is altered in 1470, 1500 & 1520 to allow a free transfer between them when obtaining the square root; this economises in memory space in the calling program.

While the general case is easily covered, there may be times when either an error in computation, or else unique combinations of values, will cause the computor to 'go mad', and these must have a guard to prevent it happening. Line 1280 contains a typical example; the variable I occurs as a divisor, and should the machine be presented with a zero value, it is advisable to draw immediate attention to the fact and enable the locality to be examined. Another example occurs in line 1471 where for a quantity purely imaginary, the normal ratio used for calculating the angle would lead to division by zero, and give a result equal to infinity which is the true value of the tangent, the computer is not equipped to deal with this, and the way around the problem used there must be adopted.

Another feature of the Basic can also set a trap for the unwary. The square of a negative number is always positive, but the computer, in common with most pocket calculators cannot deal with this situation, and the function ABS must be used for quantities squared as is done for example in line 1280.

The only case in this suite of routines where the algebraic values are not used throughout occurs in 1250. Here a multidimensional array M is used. In future programs to be covered this array will be used more frequently than any other, but it is only introduced in this one case because in a very frequently called use the inclusion

Continued on Page 50

LADNET

1235 LET A(E) = A(C)*A(D)-B(C)*B(D)	$(a+jb)(c+jd)=$
1236 LET B(E) = A(C)*B(D)+A(D)*B(C)	$(ac-bd)+j(bc+ad)$
1240 RETURN	
1250 LET A(E) = M(3,A,B,1)*M(1,C,D,1) - M(3,A,B,2)*M(1,C,D,2)	Product as above but using matrix elements with
1255 LET B(E) = M(3,A,B,1)*M(1,C,D,2)+ M(3,A,B,2)*M(1,C,D,1)	algebraic output
1260 RETURN	
1280 LET I = ABS A(D)**2 + ABS B(D)**2	$\frac{a+jb}{c+jd}=$
1281 IF I = 0 THEN GOTO 1290	$\frac{ac+bd}{c^2+d^2}+j\frac{bc-ad}{c^2+d^2}$
1285 LET A(E) = (A(C)*A(D) + B(C)*B(D))/I	
1286 LET B(E) = (A(D)*B(C) - A(C)*B(D))/I	
1287 RETURN	
1290 PRINT ES	Error in Data
1291 STOP	If Cont if Keyed
1295 RETURN	Program continues
1360 LET I = ABS A(C)**2 + ABS B(C)**2	$\frac{I}{a=jb}=$
1361 IF I = 0 THEN GOTO 1370	$\frac{a}{a^2+b^2}-j\frac{b}{a^2+b^2}$
1365 LET A(E) = A(C)/I	
1366 LET B(E) = - B(C)/I	
1367 RETURN	
1370 PRINT ES	Error in Data
1371 STOP	If Cont is Keyed
1375 RETURN	Program Continues
1450 LET A(E) = ABS A(C) B(C)**2 - ABS B(C)**2	$(a=jb)^2=$
1451 LET B(E) = 2*A(C)*B(C)	$(a^2-b^2)+j(2ab)$
1460 RETURN	
1470 LET R(D) = SQR(ABS A(C)**2 + ABS B(C)**2)	$R=\sqrt{a^2+b^2}$
1471 IF A(C) = 0 THEN GOTO 1475	$\theta=\mathrm{TAN}^{-1}\frac{b}{a}$
1472 LET T(D) = ATN(B(C)/A(C))	
1473 RETURN	
1475 LET T(D) = SGN(B(C))*PI/2	
1480 RETURN	
1500 LET A(E) = R(C)*COS T(C)	$R\,\mathrm{COS}\theta+j\mathrm{SIN}\theta=$
1505 LET B(E) = R(C)*SIN T(C)	$a+jb$
1510 RETURN	
1520 GOSUB 1476	$\sqrt{a+jb}=$
1525 LET R(C) = SQR R(D)	$\sqrt{R}\ \mathrm{AND}\ \frac{\theta}{2}=$
1526 LET T(C) = T(D)/2	$c+jd$
1530 GOSUB 1500	
1540 RETURN	

ARRAYS

A_x = REAL COMPONENT

B_x = IMAGINARY COMPONENT

R_x = RADIUS T_x = ANGLE

$M_{x_1 x_2 x_3 x_4}$ = MATRIX ELEMENT

x_1 = MATRIX NUMBER, x_2 = ROW, x_3 = COLUMN, x_4 = REAL & IMAG.

STRINGS

ES = "ERROR"

MICRO-COMPUTER UPDATE

Our tables this month give a comprehensive update on what's available on the micro scene.

Note in particular the British-made offerings; these have increased substantially over the past 6 months with prices somewhat cheaper than the imported models for very comparable specification.

Perhaps we as a nation are not going to get wiped out of the micro-computer market quite so easily as some of the prophets of gloom would have us believe.

Prices however should be treated with some caution since certain essential pieces of software, such as the operating system, are often charged for extra. The Vector Graphic for instance comes with approximately £700 of software as standard, the Xerox 820, non.

The Japanese are now very much in evidence with Sharp in particular about to overtake Apple for third position in the U.K. Certainly the Americans must be very worried especially at the middle range price band of £500 — £1,500.

One nice feature arising as a result of the British and Japanese presure on the American top dogs is that British comprehensive guarantees of 1 year, rather than the American 90 day limited warranty is becoming standard.

The Japanese competition in particular should also result in much more standard software being offered with each system rather than charging extra for it as at present.

In addition to the information contained in the tables below there are other considerations you should take into account before deciding on a particular computer.

Obviously the points to note, will differ in priority beween a business or scientific application and a home application. We have therefore listed them separately as follows:-

HOME USE

Is the system big enough for your present needs and will you be able to expand it to meet future plans? In particular look for the ability to expand memory and the availability of standard ports (RS232C or Centronics).

What period is the warranty? 1 year is now standard.

The magazines are full of interesting software programs sent in by readers. Can their Basic programs be easily adapted to run on your machine? Most dialects of Basic are easy to convert. But Tiny Basic is not usually downward compatible from Extended Basic. Others such as Acorn Basic can prove difficult.

What standard off the shelf programs exist? Games, Teaching, WP etc.

Is the system complete? Or do you have to buy connecting leads, power supplies, magnetic storage devices, output interfaces etc at extra cost.

If so how much do they come to? An RS232C interface can cost £70 for example.

Does the supplier offer a 'Help' service. Essential for a first time user. If you are contemplating a kit this should be your priority question.

Will it be possible to use a colour monitor.

THE PROFESSIONAL USER

How long has the supplier been in the business?

Is there a reference site where you can see your particular application being used.

What are the future expansion capabilities? With particular reference to disc storage, multi-user, plug-in board enhancements.

Is the system CP/M based? You may be dependent upon one supplier for your software if it is not.

Is the internal architecture based on the S-100 standard or some other common standard such as IEEE-448 or SS50? This is particularly important if it is envisaged that A-D converters, Signal processors, added memory boards, clocks etc could be needed in the future.

How many external ports, RS-232C or Centronics do you get with the system, and can you have extra at a later date? You may wish to add an extra disc drive, modems or graphics plotter to your system, or run two printers a fast dot matrix and a letter quality daisy wheel.

Is the system capable of being expanded to multi-user operation? Many now are, but insist on a demonstration with at least three terminals, as some slow down by a significant amount.

If multi-user operation is a consideration the following question should be asked.

★ Is multi tasking possible?
★ Does the OS provide record and/or file locking?
★ What about file security? Coding etc.
★ What is the maximum number of terminals?
★ How far can they be spaced apart?
★ Is the slow down in processing speed still acceptable with the max number of terminals.

Where is the system manufactured?

What is the guarantee period? Many are still only 90 days.

Is there a 24 hour on-site maintenance contract available for your area?

How much does it cost? Betwen 10 and 12% of system cost is typical.

Does the supplier have a software support team available to back up your application? This is an important consideration for most business users.

What kind of printers can I have? You will want daisy wheel for word processing applications and dot matrix for draft and label printing.

British Built Micro-computers

Company Name	Mod. No.	PRICE exVAT #	RAM size K	CPU type	VDU ?	tape ?	MAGNETIC STORAGE DOS	Floppy	Main Mkt.
Acorn	Atom	152	2	Z80	no	no			Home
BBCmicro	BBC	235	16	6502	no	no			Home
BMG	MS5001		64	8085	yes		CP/M	2x8	Bus.
Brit/"	Mimi801	1,350	64	Z80	yes		CP/M	2x5	Bus.
Brittania			64	6800	yes			2x5	
Cifer		2,357	64	2xZ80	yes		CP/M	1x5	Bus/Ed
Comart	CP-100	2,200	64	Z80	yes		CP/M	2x5	Sci/Ed
Compukit	UK101	228	4	6502	no	no			Home
Haywood	3000	1,925	64	Z80	yes		CP/M	2x5	Bus.
Clencoe	Conqrer	2,475	64	Z80	yes		CP/M	2x8	Sci/Ed
IDS Ltd	Oscar	2,495	64	Z80	yes		CP/M	2x5"	Bus.
ICL	Sys20	2,500	64		yes		own	2x5	Bus.
Io-Tech.	Iona	2,900	64	Z80	yes		CP/M		Bus/Ed
LSI	M-3	2,400	64	Z80	yes		CP/M	2x8	Bus.
MicroSol	BritGeni	2,300	64	Z80	yes		CP/M	2x5	Bus.
MicrValu	MV-3	1,550	64	Z80	yes		CP/M		Bus/Ed
Millbank	Sys10	2,995	64	Z80	yes		CP/M	2x5	Bus.
Positron	9000	1,540	64	6809	yes		OS-9		Ed/Sci
Quantum	2000	2,250	64	2xZ80	yes		CP/M	3x5	Sci/Ed
Rair	BlckBox	2,500	64	8085	yes		CP/M	2X5	Bus/Sci
Res/Mach	380Z	3,500	56	Z80	yes		CP/M	2X8	Ed
Rade	1000	1,480	64	Z80	yes		CP/M	2x5	Bus.
Shelton	Sig/net	1,299	64	Z80	yes		CP/M	2x5	Bus.
Sinclair	ZX-81	61	1	Z80	no	no			Home
Tangrine	Micron	343	8	6502	no	no			Home
Transam	Tuscan	1,449	64	Z80	yes		CP/M	2x5	Bus/Sci

Low Cost Imported Models.

Origin	Name	Mod. No.	PRICE inc.VAT (pounds)	RAM size (000)	CPU type	Does the Price include VDU ?	colour display	tape ?
USA	Apple	II	695	16	6502	no	yes	no
FE	Atari	400	345	16	6502	no	yes	no
FE	Atari	800	645	16	6502	no	yes	no
HK	APF	IM-1	400	8	6502	no	yes	yes
FE	Commdr	VIC20	200	8	6502	no	yes	no
Belg	DataApp.	Dai	684	48	8080	no	yes	no
USA	Exidy	Sorcrer	458	16	Z80	no	no	no
HK	Genie	EG3000	330	16	Z80	no	extra	yes
USA	Pet	I	529	16	6502	yes	no	no
Hol	Pearcom	PearII	975	32	6502	yes	yes	no
Jap	Sharp	MZ80K	454	20	Z80	yes	no	yes
Jap	Sharp	MZ80B	1259	64	Z80	yes	yes	yes
USA	Tandy	TRS80-I	400	4	Z80	yes	no	yes
USA	Tandy	" III	573	4	Z80	yes	no	yes
USA	Texas In	99/4	282	16	9900	no	yes	no

Can I inspect the manuals? Sloppy documentation, sloppy outfit.

What about staff training?

What other applications packages are available which could be used in my company? e.g. WP, DBMS, Financial modelling etc.

What is the capacity of the disc storage system you are being offered? Make sure it is more than sufficient for your present requirement.

Is it a dual or single drive? For most business applications a dual drive is the minimum recommended.

Is a hard disc option available? This is fast becoming the most economical way to add large amounts of memory.

What is the size of the main core memory? 64K is now the norm.

What is the user area available? The operating system always takes up some space and the more sophisticated the OS the more room it requires.

What program languages will the system support? COBOL for business software; FORTRAN for scientific; APL, PASCAL, and of course BASIC for anything.

Will I need to learn programming? Its great fun to learn anyway.

What about modifications to a program? Can this be done by the supplier?

Is there a RENTAL or LEASING scheme available, and what does it cost?

Is the computer noisy? The fan on some certainly is.

Wht is the colour of the screen? Are the characters too small? Will it be a strain on the operators eyes? Some are. And some trade unions have introduced standards.

How quickly does the representative respond to your questions before the sale? If he's slow now he certainly won't speed up after you have purchased.

More Update Tables on Page 59

Readers' Letters

ECM welcomes correspondence from readers. Please keep letters constructive and mark 'private' if not for publication. Address them to: Readers Letters, Electronics & Computing Monthly, 67 High Street, Daventry, Northants., NN11 4BQ.

Simple Modification

16th December, 1981

Dear Editor,

I enclose a copy of a letter I have sent to one of your correspondents.

Perhaps this letter, suitably modified, could serve as a letter to yourself for publication.

A simple modification would be to change four "your's" to "the". They occur in the first line (2 of them), in the last line of the penultimate paragraph ("your results"), and in the first line of the last paragraph ("your program").

Yours sincerely,
W. E. Thomson
Woodhaven
Leiston Road
Aldeburgh, Suffolk IP15 5PX

Number Puzzle

16th December, 1981

Dear Sir,

The answer to the query in a letter to Electronics & Computing (Jan 1982 issue) is that the function SQR, which relies on a series of successive approximations carried out in finite-precision floating-point binary arithmetic, cannot always get things exactly right.

The following ZX81 program allows the input of an expression and the printing, not only of its value in the usual decimal form, but also of the decimal values of the five bytes of its internal floating-point binary representation (see ZX81 programming manual, p 193, first four paragraphs).

```
10 LET A=0
20 INPUT E$
30 LET A = VAL E$
40 PRINT E$; "="; A
50 FOR I=0 TO 4
60 PRINT TAB 4*I; PEEK (PEEK 16400 +
   PEEK 16401 + I + 1);
70 NEXT I
80 PRINT
90 GOTO 20
```

Using this to investigate SQR 25 leads to:

SQR 25 = 5
131 32 0 0 1
INT SQR 25 = 5
131 32 0 0 0

So, for the ZX81, SQR 25 does *not* equal INT SQR 25, hence the results.

There are various ways of amending the program; perhaps the simplest is:

IF INT SQR A * INT SQR A = A THEN ...

(Don't be tempted to shorten this to INT SQR A ** 2 = A. This doesn't work either).

Yours sincerely,
W. E. Thomson
Aldeburgh, Suffolk

Physical Morality

Dear Sir,

An interest in computing has lead me to speculate upon the possibility of physical immortality for the individual. This idea is expanded in my article "Immortalism and Personal Computing" (Electronics and Computing Monthly (date)).

I have been in contact with various various American organisations and have amassed considerable data on this subject, which I would be willing to share with anyone writing to me. I am also willing to discuss by correspondence points raised in the article. I am also in correspondence with a small group who meets informally in London to discuss this subject, and can put those interested in touch.

Sincerely,
J. de Rivaz BSc(Eng)
West Towan House
Porthtowan
Truro, Cornwall TR4 8AX

Golf Game Program for Sinclair ZX81

18th December, 1981

Dear Sir,

I consider that the above program published in the December Issue of your magazine was very stimulating and interesting and certainly a refreshing change from the glut of variations of Space Invaders and most other Video games.

However I did find some errors in the listing when programming, which I note for your attention.

Amended lines:

```
15 FOR I = 0 TO (Y1−L)*Y1*F/L
520 LET DFILE = PEEK 16396+256*PEEK
16397+1
1070 PRINT TAB I; "□" (graphics shift H)
1680 PRINT AT 21,0; "OUT OF BOUNDS
— PENALTY SHOT"
1685 GOSUB 5010
1690 PRINT AT 0,22; SHOTS
```

Yours faithfully,
M. P. Wood
68 Bridgewater Road
Ipswich, Suffolk

Strange Results

Dear Sir,

With regard to Mr. Dowling's "Number Game" (Jan 1982), a couple of errors seem to have crept in.

Line 80 should read IF SQR A = INT SQR A . . . and line 90 has a quotation mark missing and will probably work better if inserted between lines 120 and 130.

On the other point about the ZX producing strange results with squares of number, I had not noticed this before, but by using PRINT SQR X — INT SQR X (where X is the faulty number) a curiously regular discrepancy of either 1.8626452 E-9 or 3.7252903 E-9 is found With the accuracy normally produced, in mind, this seems an unusual oversight on the part of Sinclair.

I notice that I have one of the earlier machines with 5 ICs, could this be "teething trouble" that has now been removed in the 4 IC models?

Yours sincerely,
E. Mullinger
8 Maynard Court
Clarence Road,
Windsor, Berkshire

Another Quirk

Dear Sir,

T. J. Dowling's revision of Joe Aitken's "Number Data" (Letters E&C M Jan. '82) bought a puzzling response from his ZX81 micro; that the integer of the square root of a number was recognised as equal to it's actual square root only in the case of certain square numbers (e.g. 4, 9, 16, 64 but not 25, 36, 49 and many others). My own ZX81 has the same inconsistency.

This perhaps goes with another quirk, recognised by Sinclair, in some ROMs where the instruction PRINT .125**2 gives the wrong answer.

In the meantime the program can be run successfully by deleting line 80 and writing in:

```
75 LET X = INT SQR A
80 IF X*X=A THEN PRINT AT 7,13; "AND
A SQUARE NUMBER."
```

Yours faithfully,
Pete Maguire
276 City Road
Birmingham B16 0NE
021 429 4242
P.S. Great Mag!!

CONTINUED FROM PAGE 22

Conclusion

Exotic peripherals such as slide projectors or video equipment often have to be interfaced to a microcomputer. Because no "standard" interfaces exist the problem is often solved by employing a variety of different ad-hoc interface systems. Most often these are implemented through the I/O ports made available by peripheral support chips. However, when the external I/O requirements of any particular situation exceed the capability of these chips an alternative scheme involving memory mapping can be employed. These different interfacing techniques have been illustrated by the design and implementation of circuits to enable the computer control of both sequential and random access slide projectors.

Image projection equipment of this type is often used in computer based training applications. The projectors enable a series of high resolution graphic images to be presented to trainees. Their understanding of the material embodied in the pictures is subsequently tested by multiple choice questions displayed on the computer screen. In order to control and coordinate the training resources many instructors use a special high level programming tool called an author language. This consists of a series of commands that control the various hardware items available. In the author language that we use (MUMEDALA) there is a command of the form SLIDE (P,N) which is used to control a bank of random access slide projectors. Execution of this command causes slide N to be shown on projector P. The way in which this command is implemented, via memory mapping, has been briefly outlined.

Computer controlled picture projection devices have a wide variety of applications in education, commerce and industry. They are particularly useful in situations in which the use of pictures greatly simplifies the process of communication — either between people or between a computer and its users. Currently there is much interest in the design of pictorial interfaces to information systems. Here use is made of pictures (rather than text or numbers) in order to specify the nature of the information that is to be retrieved and displayed. The success of these systems depends upon the high sematic content of pictorial images. This is adequately expressed in the well known adage, "a picture is worth a thousand words". ■

Fig. 6 Program for Automatic Slide Projection

```
100 DIM T(80), S(80)
110 POKE 59459,255
120 PRINT "□ ↓AUTOMATED SLIDE PROJECTION"
130 PRINT "**************************"
140 INPUT "↓↓HOW MANY REPEATS"; R1
150 INPUT "↓↓HOW MANY IMAGES"; S1
160 INPUT "↓DEFAULT DURATION"; D1
170 FOR I=1 TO 80 : T(I) = D1 : NEXT I
180 PRINT "↓DO YOU WISH TO SPECIFY THE
     ORDER"
190 PRINT "IN WHICH SLIDES ARE PRESENTED?"
200 PRINT "↓——— ANSWER Y OR N"
210 GET A$ : IF A$ = " " THEN 210
220 IF A$="Y" OR A$="N" THEN 240
230 GOTO 210
240 IF A$="Y" THEN GOTO 270
250 FOR I=1 TO S1 : S(I)=I : NEXT I
260 GOTO 350
270 PRINT "↓↓ENTER THE SLIDE NUMBERS IN THE"
280 PRINT "SEQUENCE YOU WISH THEM TO BE
     DISPLAYED"
290 FOR I=1 TO S1
300 PRINT "↓——— IMAGE "; I; "↑"
310 INPUT "——————————WILL BE SLIDE"; S(I)
320 POKE 33637,32 : POKE 33638,32
330 PRINT "↑↑";
340 NEXT I
350 PRINT "□↓AUTOMATED SLIDE PROJECTION
360 PRINT "**************************"
370 PRINT "↓—HOW MANY SLIDES DO NOT
     HAVE THE"
380 INPUT "—DEFAULT DISPLAY TIME"; N
390 IF N=0 THEN GOTO 500
400 PRINT "↓—ENTER THE DETAILS BELOW;"
410 PRINT "↓↓"
420 FOR I=1 TO N
430 INPUT "—————IMAGE NUMBER;" K1
440 INPUT "—————DISPLAY TIME;" K2
450 T(K1)=K2
460 POKE 33230,32 : POKE 33231,32
470 POKE 33270,32 : POKE 33271,32 :
     POKE 33272,32
480 PRINT "↑↑";
490 NEXT I
500 REM NOW CONVERT TIMES TO JIFFIES
510 REM AND CHECK FOR INVALID SLIDE
     NUMBERS
520 FOR I=1 TO S1
530 T(I)=T(I)*60
540 IF S(I) < 0 OR S(I) > 80 THEN 760
550 NEXT I
560 REM NOW COMMENCE OPERATION
570 PRINT "□↓EXECUTION BEGINS"
580 FOR I=1 TO R1
590 FOR J=1 TO S1
600 GOSUB 670 : REM GET PICTURE
610 GOSUB 720 : REM INVOKE TIMER
620 NEXT J
630 NEXT I
640 NS=0 : GOSUB 690
650 PRINT "□↓↓EXECUTION TERMINATED
660 STOP
670 REM ***RETRIEVE SLIDE
680 NS=S(J)
690 P=INT (NS/10)*16+NS-INT (NS/10)*10
700 POKE 59471,P
710 RETURN
720 REM ***TIMER ROUTINE
730 K=TI
740 IF TI < K+T(J) THEN 740
750 RETURN
760 REM *** ERROR REPORT AND ABORT
770 PRINT "□↓↓↓***INVALID SLIDE NUMBER
     SPECIFIED"
780 PRINT "***EXECUTION NOT POSSIBLE"
790 PRINT "***RUN ABORTED"
800 STOP
```

MINI VE

IN SEARCH OF

Mini Venture is designed to run on the UK101 with a new monitor and 7K of RAM but it can be run on other systems with a memory mapped display. Only minimal instructions are given in the program, but here are full instructions and a detailed program description.

You have entered a series of caves in search of gold but have managed to lose your way and cannot find the exit. There is food in the caves but your main worry is meeting one of the 'THINGS' that inhabit the caves. They come in three sizes and the bigger they are the harder they fall. If they get close enough they will leap on you and a fight will ensue. If your energy is low it will kill you. 'THINGS' will randomly appear from time to time in the tunnels between the caves — so don't hang about. The 'THINGS' do not live for very long and you may be able to out run them, but this uses up energy. To keep your energy high you need to eat as much food as possible but since you are greedy you still collect gold in case you escape. To help combat the 'THINGS' you have with you ten spells to blast them with. The spells have a limited range and are wasted if the 'THING' is out of range. More spells can be found in the caves. The more gold you collect the higher your final score but your energy will run down more quickly. Most of the gold is protected by 'THINGS' and since the caves are dark you cannot see what they contain until you reach the entrance. To pick up the gold, food etc. you move on to it and your status will be updated accordingly. The game ends when you are killed or run out of energy and die. Your final score is then displayed and this will depend on the amount of gold collected and the number of 'THINGS' killed.

The keys used to move during the game are:-

1 - Up **3 - Left**
2 - Down **4 - Right**

Pressing key 5 invokes a spell blast and the 'THING' responds accordingly. Spells vary in strength and it may take two or three to kill a large 'THING'. The keys used can be changed to suit your own personal preference by altering the keyboard scan routine at line 160-185. It is not necessary to repeatedly press a key — especially when spell blasting since the action will continue as long as the key is held down. It is not possible to move in two directions at once or move and spell blast at the same time.

The program draws the caves onto the screen and holds their contents in the array RC(x). The contents range from a single item to two items and a 'THING'. The information held in RC(x) are converted to these items by the routine at line 7000. The entrance to each cave consists of a different blank code (96) to the normal ASCII code 32 — this means that the program can detect entry to a cave and enable the entry flag (IN). The 'man' is placed at the bottom of the display and can be moved around the three caves. The caves remain blank until the 'man' reaches the entrance when the contents are then displayed. If the cave contains a 'THING' the flag M is enabled and the 'THING' is moved each time the main program loops round. When the easy game is selected the 'THINGS' move in a more random manner than in the hard game. The main program loop is quite short and the player movement is therefore fairly fast. Time consuming subroutine calls are kept to a minimum or take place when the player has stopped eg to pick up food. The cave contents are changed each time the main program loops back to the beginning but they are only displayed when the player enters a cave. Table 1 lists the program variables used and Table 2 shows the various graphic symbols used. Table 3 gives a line-by-line description of the program and from this conversion to other systems should be fairly easy.

The UK101 uses a standard 8K Microsoft Basic and it's video memory starts at location 53248 and is formatted into 16 rows by 64 columns. Unfortunately only 48-50 columns are displayable and the variable SP is set to 53259 in line 130 and not 53248 to allow for this difference. The bottom line of the display is used for messages and this is cleared and POKEd to by the routine at line 3000. The top two lines of the display are used to show the total amount of gold, spells, energy and 'THINGS' killed. The position of the 'THING' and the player on the screen is determined by the value of MP and PP which are calculated from the equation SP+64*Y+X where 64 is the line length and X,Y the co-ordinates of the 'man'/'THING'. SP and 64 can be changed to suit other systems.

The subroutine at line 9000 draws the ca
screen and from the picture shown a scheme
video displays can be worked out. The C
command clears the screen and homes th
The keyboard scan routine is enabled and
by the POKE in line 160 and can be replac
or INKEYS on other systems and the IF st
in lines 165-185 changed accordingly. The

Table 1. (Program Variables)

YP, XP Y, P	Horizontal and vertical co- player
PP, Z	Player position on screen
YM, XM	Horizontal and vertical co- 'THING'
MP, W	Position of 'THING' on scre
D1, D2, D3	Cave entrance on screen
S, SP	Temporary screen positions
SP(0), SP(1), SP(2)	Position of top left hand co
B(0), B(1), B(2), B(3)	Amount of spells, energy, fo killed
RC(x)	Contents of each cave.
WW, ZZ	Contents of location W and
XX, YY	Direction of 'THING'
KE	Memory location of keyboa
M, IN	'THING' and entry flags
M$	Message to be POKEd to scre
MS$	String containing final sco
CT	Number of battles before vi
MC	Number of moves made by TH
B1, B2, B3, B4	Contents of screen around TH spell blast
HP	Energy of spell blast
EU	Energy level of 'THING'
EL, SL, GL	Levels of food, spells, gold
FP, SE, GP	Position of food, spells, gold

on the
rother
S(12)
ursor.
played
GET
ments
nction

inates of

inates of

r of caves.
and 'THINGS'

y
G'
G' during

NTURE
GOLD

by Anthony Brown

divisor in line 155 to a larger value to lower the rate and a higher value to increase the rate. The length of time a 'THING' lives is determined by the value of MC. When the 'THING' has completed 100 movements it dies and another will appear when the flag M is enabled. The 'THING' can be made to move more quickly by calling the movement routine at line 5000 more often in the main program loop i.e. between line 230 and 235.

MINI VENTURE PROGRAMME
Page 52 ▶

Table 2 GRAPHICS CHARACTERS
Mini-Venture by A. Brown

CHRS() Code	Character	Use
4	♠Δ	Gold
9	□	Food
10	□	Clear bottom line
32	□	Space
96	□	Entrance space
128	=	Cave wall, top
135	_	Cave wall, bottom
136	|	Cave wall, right
143	|	Cave wall, left
161	█	Corridor corners
181	♣	Medium 'Thing'
207	┐	Cave corner
208	┘	Cave corner
209	└	Cave corner
210	┌	Cave corner
240	人	Man
243	⍝	Small 'Thing'
245	Ψ	Spells
252	θ	Large 'Thing'

FNR(x) defined in line 120 produces a random number between zero and x. The function FNA(x) produces a random position within the confines of cave x., the left hand corner of which is defined in line 110. The two flags M and IN have a value of -1 if TRUE and 0 if FALSE. The IF statements that test these flags do not need a second argument eg IF M=(-1) . . . if they are being tested for TRUE such as in line 205. The USR(x) function waits until a key has been pressed and it's starting address is POKED in line 100. The PEEK statement after a USR function call determines the ASCII value of the key pressed. This function could again be replaced by GET or INKEYS.

The game can be made harder/easier by either changing the energy value EU of the 'THINGS' in lines 7095 and 260 or changing the value of the food and spells in line 7075 and 7080. The rate at which the player loses energy can be altered by changing the

Table 3 - PROGRAM DESCRIPTION

100-260	Main program block
100	Enable user function; call instructions routine; initialise player
105	Screen addresses of the cave entrances
110	Disable flag M; screen addresses of cave corners
115	Initial spells and energy
130	Clear screen; erase cursor; set up screen
135-145	Set up score board
150	Randomly select cave contents
155	Reduce energy; update energy status only
160-255	Keyboard polling/player movement
185	If key 5 is pressed call spell blast routine
190	Move 'THING' if present
205-210	Toggle IN flag
215-225	Update status
235	Move player
240-250	Close entrance if open
255-260	Return to start of loop
1000-1035	Fight routine and end
1500-	Score board POKEing routine
3000-3005	Clear bottom line and POKE message
3500-3525	Update scoreboard
5000-5065	Move 'THING'
6000-6045	Spell blast
6010	Limits range of spell blast
7000-7100	Fill cave with items; determine level of food, gold etc.
8000-8075	Print instructions held in DATA statements
8025	Erase cursor
8150	Print string - justified to screen centre
8500-8565	Instructions held as DATA statements
9000-9070	Create caves on screen

16K RAM FOR ZX-81

Any new owner of the Sinclair ZX-81 soon becomes aware of the need to:
WRITE ONLY SHORT PROGRAMMES.
LEARN MACHINE CODE.
OBTAIN A RAM EXPANSION.

Sinclair, of course, market a 16K dynamic Ram expansion, but long delays in arrival, and reported unreliability have caused many to think twice (I was one of the poor unfortunates who after a couple of months wait had to send the Sinclair Ram back, and face and even longer wait for a refund).

The questions raised are:
HOW MUCH RAM?
STATIC OR DYNAMIC?
WHAT CAN I AFFORD?

After a lot of thought and enquiries I plumped for the dk'Tronics 16K Ram. This comprises of a Glass fibre, double sided PCB. There are 17 chips on board, 8 UPD416-C2 static Ram chips, 7 LS-TTL's, a 741 and a 12 volt regulator. This is a STATIC RAM unit and will therefore need a more hefty PSU than the Sinclair power unit, also the Ram chips require an additional 12 volt rail. dk'Tronics supply a suitable PSU with the 16K Ram pack at no extra cost!

The only drawback is that a higher voltage is needed for the 12v regulator, approx. 16 to 20v. This means that the SV regulator in the ZX-81 has to dissipate more power and will therefore run hotter.

Personally, I find a warm keyboard a little disconcerting, and so have taken my own measures to overcome this (the topic of a future article perhaps?!). Do not be dismayed it is all within the specification of the SV regulator and should cause no problems.

In use the Ram pack has given no trouble at all — I haven't run out of space, I have had no crashes, and no memory shrinkage. The unit is the same width as the ZX-81 and the well positioned edge connector ensures that the board fits well and doesn't rock; electrically and mechanically it is a very stable unit.

The cost including PSU is £42.95, and a recent advertisement shows it available in kit form for about £10 less, and if the initial outlay is still too high, they also supply a Ram Pack with IC sockets to enable you to start small and build up to the full 16K as you require/afford it.

dk'Tronics live at 23 Sussex Road, Gorlestone, Great Yarmouth, Norfolk.

A telephone call will evoke a polite and helpful response. Anyone for chess?

THE COMPUTE[R] TEACH[ER]

A friend of mine was recently advised by the local driving instructor that it would be very much better for his wife to have professional driving lessons as she could easily end up killing herself if she was taught to drive by her husband. He's had her out in the car for lessons twice a day since then. I'm not sure if he's hoping that the driving instructors prophecy will come true, or if he's joined the ever growing ranks of people who take the view that a professional is someone who can do for about £10 what the rest of us can do for a fiver!

This might be a rather severe attitude to adopt towards the educational scene where so much excellent professional work goes on in schools throughout the country, but armed with your home computer you are now on at least equal footing with teachers who, especially in primary schools, are not yet able to use micros in their day to day work with the children. An increasing number of young children are now arriving for their first day at primary school with a good knowledge of letters and in some cases simple words, which they have acquired through the patient and understanding interest that their parents have taken in their educational development during the pre-school years.

If you want to begin to evolve your child's literary skills then the place to start is with "building blocks" of the written word; the letters themselves. Here is a program that has been very successful in familiarising young children with letters, as it requires them to look at the letter presented to them by the computer, and then touch that same letter on the key board. This will probably be the first time that daddy's pride and joy has been allowed to sit down with his other pride and joy — his computer, so the motivation for the child to succeed will be high, and this is the time when the maximum educational benefit can be obtained.

One of the beauties of this program is that the young child does not need to be able to name the particular letter that shows on screen, it's simply a case of shape recognition as we saw in a previous feature. In this case though I would be tempted to tell the youngster the name of the letter as it appeared on screen, thereby teaching the letter while the child studies its form and shape as he compares the on-screen shape with the letters on the keyboard.

Letter recognition program:-

```
10 LET A = INT (RND-64)
20 IF A<38 THEN GOTO 10
30 PRINT AT 5,0; "Touch this letter"
40 PRINT AT 10,15; CHRS 1
50 IF NOT INKEYS ± CHRS A THEN     GOTO
50
60 PRINT AT 12, 12; "Correct"
70 FOR L ± 1 TO 50
80 NEXT L
90 CLS
100 RUN
```

After a few weeks at school your child will set out on the long road to literacy and you'll be the first to know when that memorable day arrives, for the entire evening will be devoted to a search for "A tin to keep my words in." Now, if father is a "roll your own fanatic" then there is no problem for it's either the Golden Virginia tin or the Strepsils tin, but in the non smoking household chaos reigns until a suitable container is found.

These precious words are written on "Flash Cards" to teach the child the pattern of the letters that go to make up the word, and it's a system of teaching words that lets the child pick up the words very quickly indeed, for they are soon able to name each word as they pick it out of the tin. It's a long and laborious process for the infant teacher to write out each word 30 times and pop one

HOME

R AS A NG AID

By Joe Aitken

into every child's tin, and so the whole process is taken a stage further and the words are given to the children, printed in a book, which is great if your objective is to teach actual reading, but if you are wanting to teach individual words then it's definitely second best.

Every teacher has their own individual method for reinforcing those awkward words. These range from the rap over the knuckles of yesteryear to the up to date computer assisted learning used in a few schools. Now no matter which method is used in your child's school you can be right up there with the most up to date and successful methods, if you take the words that your child is having some difficulty with, or the set word for that night's homework, and feed them into a program like this:-

```
Flash card program:-
2 PRINT "Bus"
3 GOTO 25
4 PRINT "Brian"
5 GOTO 25
6 PRINT "Stop"
7 GOTO 25
8 PRINT "Julie"
9 GOTO 25
10 PRINT "Post"
11 GOTO 25
12 PRINT "Office"
13 GOTO 25
14 PRINT "Road"
15 GOTO 25
16 PRINT "Street"
25 FOR A ± 13 TO 20
26 PRINT AT 13, A; CHRS 138
27 NEXT A
28 FOR Y ± 0 TO 40
29 NEXT Y
30 LET Z ± INT(RNDx9) x 2
35 CLS
37 UNPLOT 25, 18
40 GOTO Z
```

During the initial runs you will have to tell the little one what the word is as it appears on screen, but after a few runs the child should be beating you at it and telling you what the word is. The trick is knowing just how long to hold off saying the word during the initial teaching runs, and this comes with practice, but do remember that if the child does not know the word, and you do not tell him what it is while it's on screen, then don't worry for it will appear again in the random pattern and you can tell the child what it is at that time.

Talking of recognising words leads me to this month's mini competition. I got a letter from a reader who says that his ZX81 is a x$/xer at loading. Now I reckon to know most of the abusive words on the go but I can't find one with the first and fourth letters the same, perhaps some of our Aussie readers will be able to help. This really takes us well away from our young children and on to the promised graphics program for science and technology students. It's always a difficult thing to describe electron flow to a student. I've seen it done with coloured marbles, felt tip pens or copious amounts of chalk and a handy blackboard duster, but until I used a micro none were very successful.

BLACK GRAPHIC

I like to describe a transistor as being rather like a main road, with a side road leading off. Most of the cars travel down the main road, while a few turn off into the side road. This works well so long as all of the cars keep moving, but if one stops then the whole of the traffic flow stops until such time as the stopped car moves on. The main road is the collector-emitter current which shows on screen as the moving black graphic; the side road is the base current and shows as a grey graphic. This program shows the flow pattern in the transistor and by touching key S you can block the base current and demonstrate that the collector-emitter current flow is also blocked; to clear the blockage touch key G and the normal flow will return. It is a good way to introduce students to the working of a transistor.

You can use a similar program structure to show many other instances of current flow, such as series/parallel arrangements or the operation of a switch. In every case the computer will have enabled you to take electrical current flow out of the area of abstract study and present it in an attractive, visual and easily understood way.

The working of the N.P.N. transistor

```
5 PRINT AT 2,13; "Collector"; AT 9,4;
"Base"; AT 18,13; "Emitter"; AT 9,16;
"NPN Transistor"
10 LET A ± 21
20 LET B ± 24
30 LET D ± 19
40 LET E ± 22
50 FOR N ± 9 TO 35
60 PLOT A,N
70 PLOT B,N
80 NEXT N
90 FOR M ± 13 TO 21
100 PLOT M,D
110 PLOT M,E
120 NEXT M
130 UNPLOT 21, 20
140 UNPLOT 21, 21
145 FOR A ± 1 TO 18
150 PRINT AT A,11; CHRS 128; AT A-
1,11; CHRS 0
160 NEXT A
165 LET B ± B×1
167 IF B/10 ± INT(B/10) THEN
GOSUB 300
170 GOTO 145
300 FOR A ± 1 TO 11
310 PRINT AT A,11; CHRS 136; AT A-
1,11; CHRS 0
320 NEXT A
325 IF INKEYS ± "S" THEN GOTO 500
330 FOR B ± 11 TO 5 STEP -1
340 PRINT AT 11,B; CHRS 136; AT 11,
B×1; CHRS 0
345 IF B ± 11 THEN PRINT AT 11,
B×1; CHRS 5
350 NEXT B
370 RETURN
500 IF INKEYS ± "G" THEN GOTO 330
510 GOTO 500
```

4 RAIL MICRO COM POWER SUPPLY

The present design arose from my own need for a reasonably heavy-duty unit to supply a NASCOM 2 microcomputer with 64K memory. To allow for further expansion I decided that the +5V rail should be capable of supplying about 5 amps. The unit is fairly compact and should fit into the larger type of computer case. However if it is mounted in its own separate enclosure then it may double as a general purpose Power Supply, the voltages provided being suitable for much popular circuitry.

Regulated Outputs are:
+12V at IA
+ 5V at 5A
- 5V at IA
-12V at IA

P.C.B. ▽

Design Considerations

Although many IC's used in computer circuitry operate from a single +5V supply, there are still a great many memory devices (for instance the 4116 Dynamic RAM and 2708 EPROM) which require additional supplies at +12V and -5V. As the almost universal RS232 interface (used for teletype, printers etc.) requires +12V and --12V this means that a computer P.S.U. to be really useful must have 4 well-regulated output voltages with the +5V rail being capable of handling quite heavy currents.

A problem which has received less attention in the popular journals than perhaps it merits is that of mains-borne interference. Electro-mechanical equipment generates switching spikes which, carried by the mains, can be very troublesome and even damaging to computer circuitry. In industry, where computers may of necessity be situated near lathes, drills, pumps etc., such spikes or 'transients' may appear as spurious data, and in extreme cases may cause the destruction of MOS devices whose enormous input impedences make them peculiarly susceptible to this problem. Even the personal computer at home can be affected, as anyone will be aware who has ever entered a long programme by hand only to lose it all when the central-heating switched on!

Rather than find space for an extra P.C.B. I decided to use a suppressed mains chassis plug (Siemens type K141) with a VDR (Voltage Dependent Resistor) as an added protection against transients. The latter is a semi-conductor device which presents a high resistance to voltages below a certain threshold (in this case 400V peak) but a low resistance to voltages above that threshold. As the device 'turns on' very quickly it provides a very useful protection against sudden peaks.

PUTER

by Tony Doherty

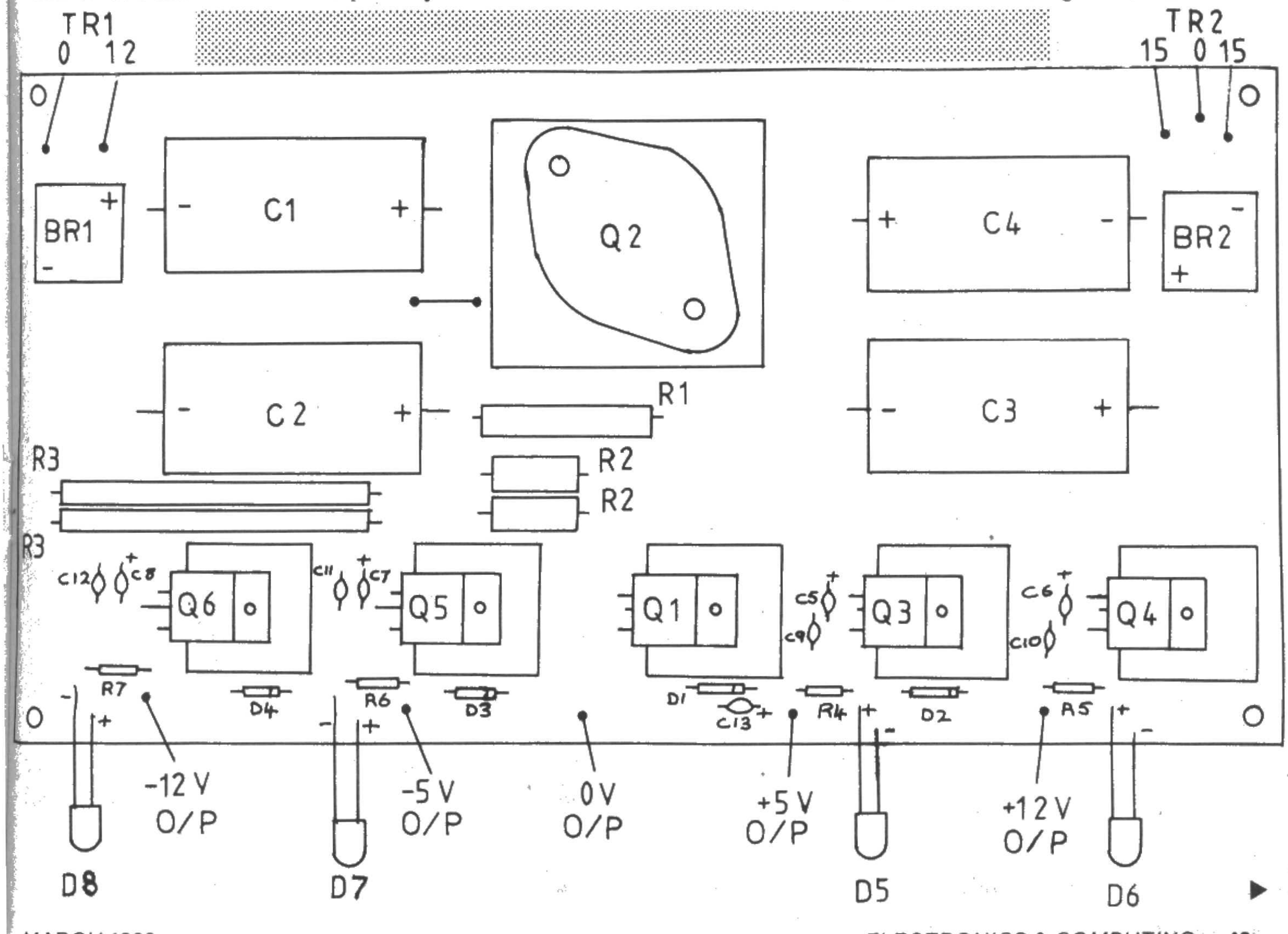
The Circuit (SEE PAGE 44)

The well-known 78 series (positive) and 79 series (negative) regulators were chosen to provide the 4 stable voltages required. These devices are internally protected against overload and are also reliable and inexpensive. Each regulator drops 2½-3V internally and therefore the unregulated supply to each must be at least this margin higher than the required output voltage.

Because of the different power ratings of the four rails and the difficulty of obtaining a transformer with suitably wound secondaries I decided to use two separate transformers. A 15V Toroidal supplies the three 1A rails. The secondaries are connected in series to give a 15-0-15 supply. This is rectified by BR2 and smoothed by C3,C4 to present partially regulated supplies to the three monolithic regulators Q4,Q5,Q6. R3 drops some of the unwanted voltage to the -5V regulator, reducing the heat dissipated by the device.

COMPONENT OVERLAY ▽

The heavy-duty +5V rail is derived from a 12V 80VA Toroidal with secondaries connected in parallel. The output is rectified by BR1, smoothed by C1,C2. A 7805 holds the output at +5V but can only supply about 1A. The rest of the current is passed by the power transistor Q2, with Q1 providing current limiting. R1 provides bias current for Q2 and Q2's collector is held at +5V by the 7805. Q1 provides current-limiting as follows. When the current through Q2 is less than about 4A the voltage across R2 is insufficient to turn on Q1 and the transistor is accordingly inactive. As the voltage across R2 rises to



■ *(Continued from Page 43)*
about .7V the transistor starts to conduct, reducing the Base-Emitter voltage of Q2 and limiting the current through the latter.

Diodes D1-D4 are included in the circuit to prevent a possible latch-up on switch-on, where one regulator might start up faster than the others and force an adjoining rail into reverse bias.

The LED's D5-D8 show that a voltage is present at each output. They may be mounted on the front panel of whatever enclosure is selected or if inconvenient may be dispensed with altogether — though they do usefully monitor the state of the power-supply.

Construction

Few difficulties should be encountered provided one observes the polarity of diodes and electrolytic capacitors. However the following points should be noted:

1. The +5V rail and the earth return rail carry quite heavy currents. If you are making your own PCB this should be allowed for in the width of track allocated.
2. Q1, Q3 and Q4 are connected via their back-plates rather than by their centre pins. The centre pins should be cut off short.
3. Q2's collector is connected to the PCB via one of the fixing screws. This is normal in a T03 package — the collector being connected internally to the metal case.
4. All transistors and IC's are heatsinked as are the two bridge rectifiers. The heatsinks should be bolted to the rectifiers before the latter are soldered to the PCB.
5. The transformers should be connected as follows:
   TR1: Red and blue connected together; Grey and yellow connected together.
   TR2: Blue and yellow connected together.
   The transformer secondary leads are quite thick and you may need a heavier bit on your soldering iron to get a good connection.
6. The PCB requires one wire link.
7. The power outlets may be hard wired to your computer bus or may be fitted with terminal pins.
8. The VDR may be soldered across the live and neutral terminals of the chassis socket.
9. 2A anti-surge fuses should be fitted in series with mains live and neutral.

Stand-Alone Construction

The whole PSU will fit NEWRAD Case type 2/37:

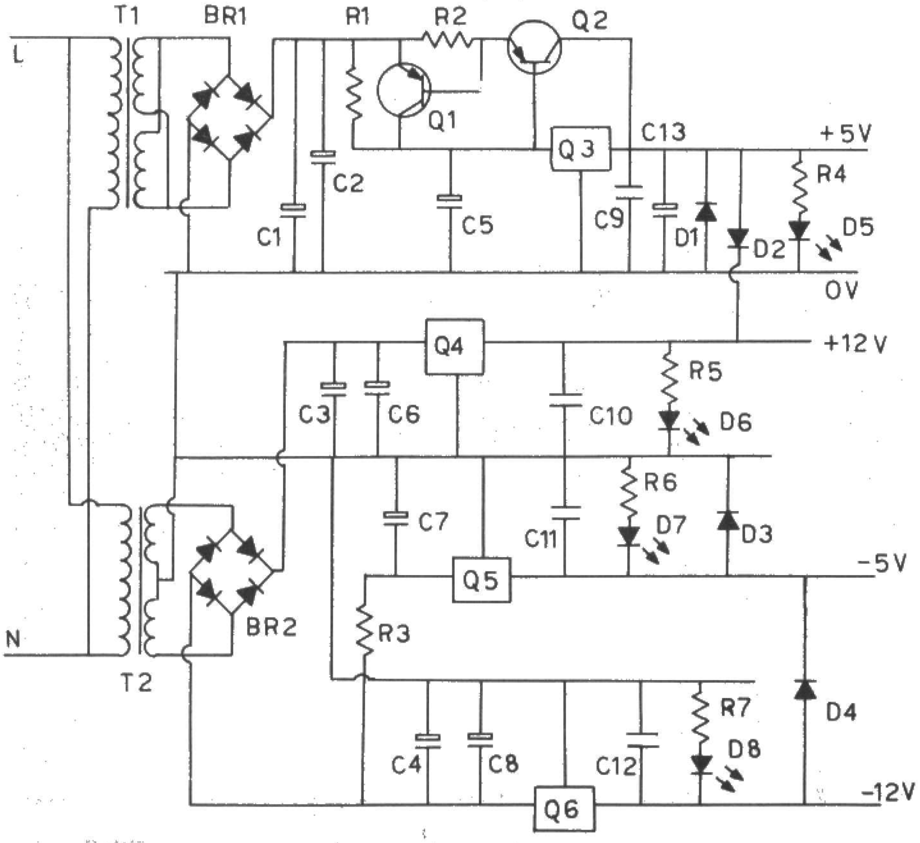
The two transformers should be mounted between the floor of the enclosure and the free chassis plate using the fixing bolts supplied with the transformers.

The PCB should be mounted on top of the chassis plate using ½" tapped pillars (6BA). Make sure the transformer fixing screws do not touch the PCB.

The chassis plug and fuse holders may be fitted to the rear panel. The power outputs (including 0V) should be brought out to insulated terminals mounted on the front panel. The four LED's may be mounted directly over the appropriate power outlet.

A single earthing point should be mounted on the chassis to which mains earth and 0V should be connected.

4 RAIL P.S.U.



Parts list

R1 : 2R4, 3W.
R2 : 2 x 0R22, 2½W, connected in parallel.
R3 : 2 x 15R, 7W connected in parallel
R4 : 200R,
R5 : 750R
R6 : 200R
R7 : 750R

C1, C2 : 4,700μ/40V electrolytic.
C3 : 2,200μ/40V electrolytic.
C4 : 4,700μ/40V electrolytic.
C5-C8 : 2.2μ/35V tantalum.
C9-C12 : .1μ Ceramic.
C13 : 10μ/25V tantalum.

BR1, BR2 : BR64 (6A).
D1-D4 : 1N4002 (1A silicon diodes).
D5-D8 : LED's to suit.
Q1 : TIP42A
Q2 : MJ2955
Q3 : 7805
Q4 : 7812
Q5 : 7905
Q6 : 7912

Miscellaneous

TR1 : 80VA 12V Toriodal (ILP type 32012).
TR2 : 80VA 15V Toriodal (ILP type 32013).
VDR : 240V RMS rating (RS Components).
7 small heatsinks for X75 package — Electrovalue type TV4. T03 heatsink — Electrovalue type TV3 Vero Pins; 20mm Fuseholders; 2A anti-surge fuses; suppressed chassis socket Siemens type K141; insulating bushes for MJ2955; 4 LED's and mounting bushes.

Extra parts for stand-alone construction

NEWRAD instrument case type 2/37; 5 insulated 4mm terminals (Electrovalue type TP1) — choose different colours to distinguish the outputs; 4 x 6BA ½" tapped pillars; 8 x 6BA ¼" screws,

All parts used in the project are stocked by Electrovalue Ltd., but most are fairly standard and should be readily available elsewhere. ■

Generating electricity from the wind without moving parts

by J. de Rivaz

Generation of electricity from the wind is well known. Usually a propellor is turned into the wind, and is used to turn a generator. Sometimes this is via a step up gearbox or belts. Problems arise because of the need to turn the propellor into the wind. As the machines twists and turns in gusts, gyroscopic forces put an extra strain on the tower, which also carries the large weight of the generator.

One modification to get over these gyroscopic forces is used on a machine called the Trimblemill. This uses contra-rotating blades. This also means that no step up gearing is needed as the generator has both field and armature rotating in opposite directions. However, there is a high cost to be paid for this technology, and sets are of the order of 64p per peak watt for a 12.5 kW machine. This does not compare favourably with the potential of solar electricity, but it is available now rather than in the future.

Another alternative is the vertical axis machines. These use vertically mounted propellors, that don't need pointing into the wind. A single rotating column can be the combined mast and shaft to drive a generator, mounted with the shaft vertical, on the ground. Some designs have the advantage that the blades feather individually, so when the wind drops in gusty conditions they don't waste energy by acting as blowers. Others have variable geometry, so that in high wind speeds they can still generate energy, but don't run so fast as to fly apart. Horizontal axis machines have to shut down after the wind gets to a certain speed.

However, which ever way one does it, rotating machinery held high aloft is always a potential danger and is going to need regular and careful maintenance.

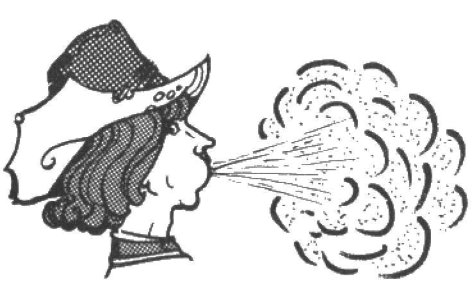
Therefore if a static method can be found to generate electricity from the wind, then it will be at a distinct advantage, especially if it is cheaper as well.

The first time

the writer heard of this possibility was in an obscure magazine that was originally about "alternative technology", called Undercurrents. In the issue No. 12 a few lines described an electrostatic aerogenerator made by a M. Clitton in France. The whole thing seemed rather unlikely and was only given passing thought.

However in January 1978 an article appeared in the Institution of Electrical Engineers' monthly magazine "Electronics and Power" called "Sparks from Steam". This described how static electricity was made in the 1840s from jets of steam. The largest generator was of considerable power. However, it is not easy to convert high voltage high impedance DC to more useful levels of AC voltage and current, so the matter was never taken up. Mechanical generation became the norm.

Then in March of that year, a further article appeared in "Electronics and Power" describing the work of the Marks Polarised Corporation (153-16 Tenth Avenue, Whitestone, NY 11357, U.S.A.) This corporation, under its president Alvin M. Marks, is researching into a "Charged Aerosol Wind/Electric Power Generator". At a symposium on electrohydrodynamics at Colorado State University in January 1978 Mr Marks presented a paper on experiments on using charged water droplets to generate power from the wind.



These droplets are pre-charged and emitted into the wind stream. As they are blown away from the emitter, work is done on them by the wind moving them along a potential gradient between it and the ground. The electrical load is connected between the source and the earth, ie there is no collector electrode as such. An experimental nozzle was built that gave an output of 312 microwatts for a charging power of 86 microwatts.

It is suggested in the paper that a large area electrode screen would generate 450 w/sq.m in a wind of 10 m/s.

The problem of D.C.

However, even if one has the power available, it will still be a high voltage D.C. The technology to convert this to a low voltage A.C. at 50 Hz to power domestic appliances is likely to be expensive. Electrostatic motors are possible, but again it is unlikely to be practical to have an alternator driven by such a motor.

The Undercurrents article first mentioned discussed an AC machine. In this system, "electrostatic packets of air" are injected into the windstream, and collected by a grid downstream. As they pass through this grid, they are said to induce alternating potentials. The frequency depends on the velocity of the wind and the velocity of the injecting potential. The inventor suggests that a constant output can be obtained by controlling the injector frequency by electronic servo.

It is difficult to see why in this case the output would alternate around zero as opposed to pulsing unidirectionally from zero — something quite different. In order to get AC it may be necessary to alternate, rather than just pulse, the injector potential.

Also, it is clearly better to use the earth as the collector. Aiming the particles at a grid implies that the wind direction is important.

Suggested lines for experiment

A convenient source of high voltage is a capacitor discharge ignition unit feeding a car coil. Two units could be used, one giving positive pulses, the other negative. The two units would be driven from a two phase oscillator, so that they come on alternately.

This unit would be placed at the high voltage end of the primary of a transformer converting 100Kv to 240v. A re-chargeable battery would also have to be floated at the high voltage end to provide start up current. Of course once the machine started, this battery would be charged from generated current from a winding on the transformer.

It is not known at present what limitations there are on frequency. However, the higher the frequency that could be generated, the smaller and cheaper the transformer required. Televisions include apparatus to generate about 25kV at 15.625kHz and subseqently rectify it.

This idea was presented to the IEE in the form of a letter by the writer, which was published in June 1978.

In October a further letter appeared suggesting some snags. The main one seemed to be that the internal impedance of the system would be high — of the order of hundreds of millions of ohms at 50 Hz per electrode. (This means you need a great many electrodes!) Another relating to this is the coupling between the charged particles and the air. Energy can only be extracted by slowing the air down, and with a charged particle generator this has to be done by the charged particles.

However, one possible alternative was suggested. That is using ionised air instead of charged particles. If every molecule were singly ionised the charge would be 900 coulombs per litre. It is unlikely that this theoretical maximum could be reached, but nevertheless it appears better than the case with aerosols. With aerosols, Mr Marks suggest that the optimum radius/no of electrons per droplet is 120 Angstroms/1 electron. But the charge per electron is 1.6×10^{-19} coulcombs!

Unfortunately, the practicality of apparatus involving ionised air working in all weathers is not good.

Conclusions

The main problem with power from the wind is that this power is very diffuse. Mechanical methods of collecting it involve large expensive structures. When electrostatic methods are considered, this problem turns to one of high impedances. This means the difficulties of large structures become the difficulties of dealing with high voltages.

Nevertheless, the cash rewards for a cheap domestic aerogenerator are large. If an effective design can be found, the government will have less justification for the nuclear programme, with its attendant problems. Also, a large factor in inflation, fuel costs, will be reduced. ■

A Digital Logic Probe

by Harry Fairhead

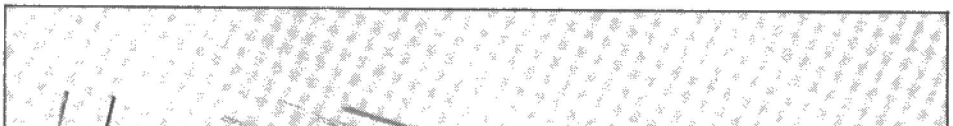
The kit under review this month is Global Specialties Corporation's Logic Probe Kit, LPK-1. Why build a logic probe from a kit? Well, first let's see why you might want a logic probe in the first place. A logic probe detects and displays logic levels, pulses and pulse trains. In other words it indicates the logic state of any point in a circuit. This makes it a useful piece of test equipment for digital repair work or for commissioning new circuits.

The advantages that a logic probe has compared to its alternatives, a logic analyser or an oscilloscope, are that it is easier to use; that is easily portable, which makes it suitable for field maintenance applications; and very much cheaper. While you'd need thousands of pounds for a logic analyser, and hundreds of pounds for an oscilloscope, you can buy a rudimentary logic probe for under £20. For this reason alone the logic probe is likely to be the one piece of digital test equipment that an enthusiast will acquire.

The question of financial outlay brings us to the reason why you might prefer to build a kit to buying a ready assembled logic probe — you can make a worthwhile saving for just an hour or so's work. In the case of GSC's products you can save over a third of the purchase price of the built logic probe by putting the kit together. While the kit costs £15.52 (including VAT and postage and packing) the finished article (which is the LP-2) costs £22.14 (inc.).

If you are keen to make limited funds stretch, why not go the whole hog and build a logic probe from scratch? This is certainly a possibility. The main snags are making your circuit fit on to a small enough board and in finding a suitable casing. A logic probe has to be the right size and shape to be hand-held. I have seen the tubes that single cigars are sold in used as cases, but for the professional finish GSC actually sell a purpose designed case (for £4.88 inclusive of VAT and postage and packing).

There are a variety of logic probes available so how do you choose between them? In general, the more you pay the more sensitive the probe you'll acquire. GSC market a range of probes and this kit is at the bottom end. The main way in which the more expensive probes differ is that they can detect much faster signals. Once built the LPK-1 will detect a minimum pulse width of 200 nanoseconds while the LP-3, at £58.08 (inc) will capture pulses as narrow as 10 nanoseconds. (Ten nanoseconds is the fastest pulse that can be generated by TTL logic). All the GSC probes are suitable for TTL, DTL, HTL and CMOS logic levels. If you want a probe that is dedicated to just one of these types then you will be able to get a more powerful probe for less cost.



■ P.C.B. & Components.

The LPK-1

The kit comes neatly packaged on a piece of stiff card. Once you've got through the plastic wrapping you'll discover a booklet of instructions for building and operating the probe. Its grey plastic case, a printed circuit board cut to the correct shape to fit inside (it is in fact packed inside the case) and all the components packed together in one plastic bag (also contained inside the case). The components comprise seventeen resistors, eight capacitors, three diodes, three LEDs, two transistors, one integrated circuit and a number of additional bits of hardware (including the PCB, the probe tip, a power cord and adhesive labels and of course the case). Although the electronics components would cost you only about £3 and would be readily available, it is these other bits and pieces that would be more difficult to obtain or substitute for.

In addition to a comprehensive parts list, the instruction booklet gives a page showing diagrams of each type of component, and a resistor colour code chart. In this aspect the kit is an especially suitable one for a beginner. On the other hand there are no instructions on how to use a soldering iron which other beginner's kits often include — the instructions simply advise that to keep the soldering iron tip clean it should be wiped often with a sponge.

Rather than the usual wordy instructions, the part of the assembly instructions about placing components on the PCB is all covered in two anotated diagrams. These are very clear but may be rather too abbreviated for the beginner. The diagrams are, however, very necessary as there is no indication on the PCB of where to position the components. PCBs often have silk screen overlays which show the positions each numbered component will occupy — there is no such guidance in this kit so it is a case of using the diagrams to work out which drilled holes relate to each resistor, capacitor, etc. This is just a niggling

criticism but I found that it was rather misleading to have a diagramatic instruction suggesting that I prepare my soldering iron right at the beginning when in actual fact the instructions meant me to place in position all the resistors and the IC and then solder all of them to the PCB in one go and, similarly, then to posdition all the other components before doing the rest of the soldering.

The diagrams included in the remainder of the instructions were also very clear. The instructions suggest you use a quick-drying glue for securing the LED holder in position. I used "Superglue" which fastened it immediately. I would advise using "Superglue" — but be careful you position it exactly as there can be no second chances!

I was pleased to note that the instructions advise you to check that the probe is working before putting the circuit into its case. Details of an appropriate test are given and as long as you've followed the assembly instructions you should experience no trouble. If you do not get the response described, however, a useful troubleshooting chart is included, listing the most common problems and their remedies.

I found the final assembly the most difficult part of building this kit. The problem is withouble. If you do not get the response describe, however, a useful troubleshooting chart is included, listing the most common problems and their remedies.

I found the final assembly the most difficult part of building this kit. The problem is with getting the three LEDs into their holes. This needs a combination of firmness and gentleness. You need to be patient at this stage or you may ruin your work.

Even though I found this stage tricky, the whole assembly took well under an hour and I would imagine that even a novice circuit builder could complete the kit in about an hour.

The manual includes two pages about testing the digital logic probe without explaining why these tests — a threshold test and a pulse test — are required. The short answer is that they are not really necessary. They check the calibration on the probe but if the probe works then it is reasonable to consider that it is working to specification. So if you do not have the equipment needed (a 5 volt regulated power supply, a digital voltmeter and a linear potentiometer) then do not fret — just assume your probe is properly calibrated UNLESS IT GIVES YOU STRANGE RESULTS! For example, take a circuit you know about and which you are confident is working properly and see if the probe gives you the signals you'd expect. If at any stage of the testing you find the probe is faulty and you cannot put it right then return it to GSC at their address in Essex. Whether or not a charge is made for the repair will depend on whether the fault was caused by your incorrect assembly of the kit or a defective part being supplied originally.

The booklet explains how the probe is used and gives a chart to help interpret the signals emitted. However, there is actually a lot more to know about the use of your logic probe — and this will be dealt with next month.

Conclusion

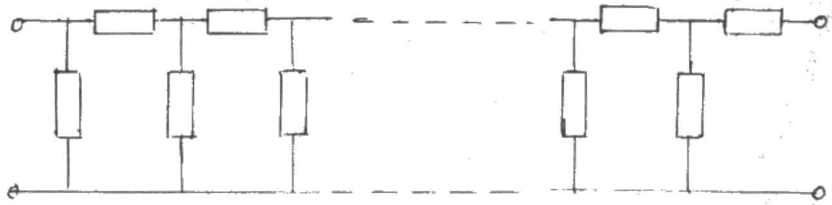
This is an attractively presented kit which is suitable for the inexperienced kit builder, though the absolute beginner would need some additional instructions. Balancing out time against cost, the LPK-1, seems to offer a worthwhile saving over comparable ready built logic probes. However, before you rush out to buy one consider the applications you wish to use your probe for and decide whether a pulse width of 300 nanoseconds is sufficiently accurate. If this sounds like excessively complicated advice be sure to buy next month's Electronics and Computing for the second part — How to Use a Logic Probe. ■

C.A.D.

Continued from Page 28

here will save a fair amount of memory space. The array covers the elements of a series of matrices, without the use of which the calculation of networks would be hopelessly clumsy and wasteful of memory space. More will be said about this use when the logic of computation employed is covered in future articles.

For convenience of reference this set of programs has been christened 'LADNET' because it has been designed to deal with the family called ladder-networks. The typical ladder network is a series of impedances arranged as a four terminal circuit in which one input and one output are strapped together, and usually taken to ground, while the other two are joined by a number of element in series interspersed with others shunting various locations along the chain to ground. This is a common form of electrical wave-filter, the other common form consisting of two series arms balanced to ground, and shunted by elements between similar points in the two arms. This form, the balanced ladder network, can be dealt with by this program over the frequency range only in which it is truly balanced to earth.



Typical Ladder Network.

A two active armed network, in which the two points joined by shunt elements are not located at similar points in the two arms, is called lattice type, and is not covered by this program. One type, not a true ladder, but so frequently used, and amenable to the methods used here, is covered, and is usually called a 'tee filter'. Two further forms, frequently used in conjunction with ladder networks, the transformer and the transistor driver are also covered, although the use of the 'active' net destroys the two-way symmetry normally associated with purely passive sections.

A diagrammatic ladder network is shown in the figure, and where the number of sections might well exceed ten, the amount of memory required to deal with it as a whole, would be excessive. This problem is overcome in the present proposal by storing only the values of the components, evaluating progressively along the net, so that only the intermediate values of one section have to be stored, and also tackling only one frequency at a time. For the final output therefore only the overall transmission over the chosen frequency range has to be stored at the steps chosen, but the intermediate results can be automatically output n the printer before they pass from memory. This ability to output many sets of intermediate values on printer by a suitable setting of a debug variable index at any stage of running, allows valuable flexibility in locating unsuspected faults in local configurations.

It also allows an initial run to be made at small range of log-spaced frequencies on the initial scan, and then to enter a much smaller range of closely spaced frequencies on the initial scan, and then to enter a much smaller range of closely spaced frequencies in a region where more detailed view is desired of a rapidly changing characteristic. ■

ELECTRONICS & COMPUTING MONTHLY insurance bureau

Type of Borrowing	Amount (£)	Payments (£)
BEFORE		
Building Society Mortgage	5,000	65
Car H.P.	2,000	100
Credit Cards	500	50
Second mortgage	1,500	45
Bank Loan	1,000	50
	10,000	310
AFTERWARDS		
Building Society mortgage	10,000	145

Money, money, money!

There's never quite enough of it, is there? Especially at this time of year, with the aftermath of Christmas spending to contend with, coupled with heavy quarterly bills. Furthermore it is the season of glossy holiday brochures, beckoning you on to spend even more money you haven't got!

This month I thought we might take a look at personal finances, particularly relating to borrowing money.

The problems of getting it — and then repaying it

It seems to me that there are two problems. Firstly, getting hold of the cash one needs. You may have in mind a home extension, replacement windows, double glazing or even a new car for the Spring. The second problem is coping with the level of repayments that build up. Not only is there the mortgage, but also H.P., Bank loans, second mortgages and those credit card repayments! The gradual increase of these monthly outgoings can become a worrying burden.

But what really is the problem?

I believe that the real problem is the build up of **short term** borrowings. Most of the sources of finance mentioned above require repayment in two years or less. Wouldn't it be much better to spread them over a much longer period?

Remortgages

You may well reply that this is surely easier said than done. But there is a way that is worth investigating. Most people who have owned a house for a few years have now built up substantial equity in the property. Houses worth £30,000 very often have a mortgage of only £5,000 to £10,000 outstanding to the Building Society. The idea of a remortgage is to approach another Building Society for a completely new FIRST mortgage on your house. We are **not** talking about a second mortgage in addition to your present Building Society loan. We call this process remortgaging the property.

How to do the sums

The way to go about it is to add up all your present borrowings. The example below illustrates this process. You may well find that you have loans of various sorts that tot up to £5,000. You then add this total to your present Building Society loan, which might be another £5,000, and then seek a new mortgage for the whole £10,000! Out of this figure you pay off the present Building Society and all the other loans. You then have only one debt and one monthly payment.

Reduced outgoings

All E.C.M. readers are numerate people, I am sure! So everyone will have noticed the dramatic reduction in outgoings. Some will correctly argue that they have now committed themselves to these repayments for 25 years. This is quite true. But think about the impact of inflation on your original mortgage. Surely it makes sense to spread your repayments over as long as possible, reduce your outgoings now and so increase your spendable income TODAY!

Remortgages available now

Obviously this idea will not appeal to everyone. It will also not be available to everyone for various reasons relating to each individuals personal circumstances. If, however, you believe reorganizing your repayments would be helpful, or you have some major item of expenditure in mind where a remortgage might apply, then take a look at the idea.

Remortgages are available from some Societies at present. Whether you get one depends on the facts of the case and how they are presented. You can approach your insurance advisor who may be able to guide you. If you wish to complete the coupon below and mail it to us, we will pass it on to a sister organization of ours that specializes in this area.

I hope that this article will help you to have a financially more comfortable 1982!

Name .... Age ....
Address ....
...... Day Tel. No. .... Home Tel. No. ....
Value of house (est) .... Age of house ....
Present B/Soc loan ... Total other loans O/s ....
Total monthly repayments (including B/Soc) ....
Mail to: ECM Insurance Bureau, 18 Hamilton Road, Nottingham NG5 1AU.

Mini/Venture Program

```
100 POKE 11,0: POKE 12, 253: GOSUB 8000: SP=53259: YP=14: XP=25:
PP=SP+YP*64+XP
105 D1=53916: D2=53668: D3=53932: KE=57088: IN=0
110 M=0: SP(0)=53711: SP(2)=53278: SP(2)=53741
115 B(0)=10: B(1)=100:
120 DEF FNR(X)=INT (RND (1)*(X+1))
125 DEF FNA(X)=SP(X)+64*(FNR(4)+1)+FNR(11)+1
130 PRINT CHR$(12): POKE 53325,32: GOSUB 9000: SP=53259
135 S=53325: M$="ENERGY": GOSUB 1500: S=53362: M$="SPELLS":
GOSUB 1500
140 S=53389: M$="GOLD": GOSUB 1500: S=53426: M$="THINGS":
GOSUB 1500
145 GOSUB 3500
150 FOR I=0 TO 2: RC(I)=FNR(10): NEXT
155 B(1)=B(1)-B(2)/100: GOSUB 3520: IF B(1)<1 THEN 1020
160 POKE 530,1: POKE KE,127: A=PEEK (KE): POKE 530,0: X=XP: Y=YP
165 IF A=127 THEN Y=Y-1
170 IF A=191 THEN Y=Y+1
175 IF A=223 THEN X=X-1
180 IF A=239 THEN X=X+1
185 IF A=247 AND M THEN GOSUB 6000
190 IF M THEN GOSUB 5000
195 Z=SP+Y*64+X: ZZ=PEEK(Z)
200 IF ZZ=32 THEN GOTO 235
205 IF ZZ=96 AND(IN) THEN IN=0: GOTO 235
210 IF ZZ=96 AND IN=0 THEN IN= -1: GOSUB 7000: GOTO 235
215 IF ZZ=4 THEN B(2)=B(2)+GL: GOSUB 3500: GOTO 235
220 IF ZZ=182 THEN B(1)=B(1)+EL: GOSUB 3500: GOTO 235
225 IF ZZ=245 THEN B(0)=B(0)+SL: GOSUB 3500: GOTO 235
230 GOTO 255
235 POKE PP, 32: XP=P: YP=P: PP=SP+64*YP+XP: POKE PP,240
240 IF PEEK(D1)=32 THEN POKE D1,96
245 IF PEEK(D2)=32 THEN POKE D2,96
250 IF PEEK(D3)=32 THEN POKE D3,96
255 IF M THEN 150
260 IF FNR(100) <1 THEN M= -1: EU=FNR(60)+1: XM=25: YM=12
265 GOTO 150


1000 FOR I=1 TO 240: POKE PP,I: NEXT: IF FNR(10)<3 THEN CT=CT+1:
GOTO 1000
1005 B(1)=B(1)-EU: IF B(1)>1 THEN 1035
1010 POKE PP, 32: IF CT<=2 THEN M$="... IT GOT YOU ...": GOSUB 3000
1015 IF CT>2 THEN M$="... AFTER A GREAT BATTLE - IT GOT YOU ...":
GOSUB 3000
1020 FOR X=1 TO 2000: NEXT: MS$=STR$(INT(B(3)+B(2)/100)):
GOSUB 3500
1025 M$="... YOUR FINAL SCORE IS"+MS$+"POINTS ...": GOSUB 3000
1030 PRINT: PRINT: PRINT: END
1035 MC=0: CT=0: B(3)=B(3)+1: GOSUB 3500: POKE MP,32: M=0: RETURN
1500 FOR I=1 TO LEN(M$): POKE S+I, ASC(MID$(M$,I,1)): NEXT: RETURN


3000 FOR I=54219 TO 54269: POKE I,10: NEXT: L=LEN(M$)
3005 FOR I= 1 TO L: POKE(54244-L/2)+I, ASC(MID$(M$,I,1)): NEXT:
RETURN


3500 FOR I=54219 TO 54269: POKE I,10: NEXT
3505 M$=STR$(B(2))+" ": S=53396: GOSUB 1500
3510 M$=STR$(B(3))+" ": S=53432: GOSUB 1500
3515 M$=STR$(B(0))+" ": S=53368: GOSUB 1500
3520 M$=STR$(INT (B(1)))+" ": S=53332: GOSUB 1500
3525 RETURN


5000 MC=MC+1: MP=SP+64*YM+XM: IF MC>100 THEN M=0: MC=0:
POKE MP,32: RETURN
5005 U=XM: V=YM: XX=INT(SGN(XP-XM)*FNR(SK)+.5)
5010 YY=INT (SGN(YP-YM)*FNR(SK)+.5)
5010 IF XX=1 THEN U=U+1: GOTO 5035
5020 IF XX= -1 THEN U=U-1: GOTO 5035
5025 IF YY=1 THEN V=V+1: GOTO 5035
5030 IF YY= -1 THEN V=V-1
5035 POKE MP,32: W=SP+64*V+U: WW=PEEK(W)
5040 IF WW=32 OR WW=96 THEN XM=U: YM=V: GOTO 5055
5045 IF WW=240 THEN 1000
5050 RETURN
5055 MP=SP+64*YM+XM: IF EU>=80 THEN POKE MP,252: RETURN
5060 IF EU<80 AND EU>30 THEN POKE MP,181: RETURN
5065 POKE MP,243: RETURN


600 IF B(0)>0 THEN 6010
6005 M$="... YOU DON'T SEEM TO HAVE ANY ...": GOSUB 3000: RETURN
6010 B0)=B(0)-1: IF ABS(YM-YP)<3 AND ABS (XM-XP)<6 THEN 6020
6015 M$="... MISSED ...": GOSUB 3500: RETURN
6020 B1=PEEK(MP-64): B2=PEEK(MP+64): B3=PEEK(MP-1):
B4=PEEK(MP+1)
6025 FOR S=100 TO PEEK(MP): POKE MP,S: POKE MP+64,S: POKE MP-64,S
6030 POKE MP+1,S: POKE MP-1,S: NEXT
6035 POKE MP-64,B1: POKE MP+64,B2: POKE MP-1,B3: POKE MP+1,B4
6040 HP=FNR(30): EU=EU-HP: IF EU>1 THEN RETURN
6045 POKE MP,32: M=0: MC=0: EU=0: B(3)=B(3)+1: GOSUB 3500: RETURN


7000 IF Z=D1 THEN T=0
7005 IF Z=D2 THEN T=1
7010 IF Z=D3 THEN T=2
7015 IF RC(T)=0 THEN RETURN
7020 ON RC(T) GOTO 7025, 7030, 7035, 7040, 7045, 7050, 7055, 7060,
7065, 7070
7025 GOSUB 7075: RETURN
7030 GOSUB 7090: RETURN
7035 GOSUB 7080: RETURN
7040 GOSUB 7085: RETURN
7045 GOSUB 7090: GOSUB 7075: RETURN
7050 GOSUB 7090: GOSUB 7080: RETURN
7055 GOSUB 7090: GOSUB 7085: RETURN
7060 GOSUB 7090: GOSUB 7075: GOSUB 7080: RETURN
7065 GOSUB 7090: GOSUB 7075: GOSUB 7085: RETURN
7070 GOSUB 7090: GOSUB 7080: GOSUB 7085: RETURN
7075 EL=FNR(50)*FNR(2)+1: FP=FNA(T): POKE FP,182: RETURN
7080 SL=FNR(5)+1: SE+FNA(T): POKE SE,245: RETURN
7085 GL=FNR(50)*FNR(2)+1: GP=FNA(T): POKE GP,4: RETURN
7090 IF M THEN RETURN
7095 EU=FNR(50)*FNR(2)+1: Y1=INT((SP(T)-SP)/64): M= -1
7100 YM=Y1+FNR(4)+1: XM+(SP(T)-SP)-Y1*64+FNR(11)+1: RETURN


8000 M$=CHR$(12): GOSUB 8150
8005 M$="DO YOU WANT INSTRUCTIONS?": GOSUB 8150: X=USR(X)
8010 IF PEEK(531)<>89 THEN 8060
8015 M$=CHR$(12): GOSUB 8150
8020 FOR I=1 TO 15: READ M$: GOSUB 8150: NEXT
8025 POKE 54221,32: X=USR(X)
8030 M$=CHR$(12): GOSUB 8150
8035 FOR I=1 TO 10: READ M$: GOSUB 1850: NEXT
8040 M$="TREASURE -"+CHR$(4): GOSUB 8150
8045 M$="FOOD -"+CHR$(182): GOSUB 8150
8050 M$="SPELLS -"+CHR$(245): GOSUB 8150
8055 M$="THINGS -"+CHR$(243)+","+CHR$(181)+","+CHR$(252):
GOSUB 8150
8060 M$="DO YOU WISH AN E-EASY OT H-HARD GAME?": GOSUB 8150
8065 X=USR(X): IF PEEK(531)=69 THEN SK=2: RETURN
8070 IF PEEK(531)=72 THEN SK=1: RETURN
8075 GOTO 8065


8150 PRINT TAB(24-LEN(M$)/2)M$: RETURN


8500 DATA MINI VENTURE, " "
8050 DATA The object of this game is to survive!
8510 DATA " ", You are trapped in a maze of caves that are
8515 DATA inhabited by THINGS! The caves also contain
8520 DATA TREASURE and FOOD, as well as SPELLS which are
8525 DATA quite effective against the things. Fighting
8530 DATA and carrying the gold drain your energy -
8535 DATA so collect as much food as possible.
8540 DATA " ", To collect the food etc move your man onto it, " "
8545 DATA " ", Press any key to continue
8550 DATA The following keys are used to move around -
8555 DATA " ", 1 - to move up, 2 - to move down, 3- to move left
8560 DATA 4 - to move right, " ", Press 5 to spell blast the 'things'
8565 DATA " ", "The following symbols are used -"


9000 FOR I=0 TO 2: FOR J=0 TO 12: POKE SP(I)+J,128:
POKE SP(I)+J+384,135: NEXT
9005 FOR K=SP(I)+63 TO SP(I)+321 STEP64; POKE K,143:
POKE K+14,136: NEXT K,I
9010 FOR I+53729 TO 54241 STEP64: POKE I,143: POKE I+6,136
9015 IF I=53921 OR (I+6)=53927 THEN POKE I,32: POKE I+6,32
9020 NEXT
9025 SP=53853: FOR I=0 TO 3: POKE SP+I,128: POKE SP+11+I,128:
POKE SP+128+I,135
9030 POKE SP+139+I,135: NEXT
9035 S=210: POKE 53671,S: POKE 53991,S: POKE 53980,S
9040 S=209: POKE 53852,S: POKE 53863,S
9045 S=208: POKE 53857,S: POKE 53868,S
9050 S=207: POKE 53665,S: POKE 53996,S: POKE 53985,S
9055 S=96: POKE D1,S: POKE D2,S: POKE D3,S
9060 S=161: POKE D2-1,S: POKE D2+1,S: POKE D2-2,S: POKE D2+2,S
9065 S+10: POKE 53740,S: POKE 53724,S: POKE 53675,S: POKE 53661,S
9070 RETURN
```

HOME BUSINESS PROGRAM

by John Higgins

ASSIGNMENTS FOR 'DIM' STATEMENTS

DIM A(31)

A(1)	- Input for options
A(2)	- B.S. savings balance
A(3)	- B.S. interest rate
A(4)	- B.S. monthly payment
A(5)	- B.S. Withdrawals
A(6)	- B.S. Monthly interest
A(7)	- B.S. Total interest
A(8)	- B.S. Total Withdrawals
A(9)	- B.S. Total payments
A(10)	Bank-Bal
A(11)	Expenditure
A(12)	Salary
A(13)	Ins Payment
A(14)	Total expenditure (month)
A(15)	Total Pay
A(16)	B/F from 1981
A(17)	Total (B/F + Total pay)
A(18)	Expenditure
A(19)	Monthly-Bal
A(20)	Current-Bal
A(21)	Total ins payments
A(22)	Total Bal.
A(23)	Remainder Spare

DIM B(10)

B(1)	Month number (for B.S. program)
B(2)	Year number
B(3)	Previous year number
B(4)	Month number (Bal. sheet)
B(5)	Etc. Spare

```
FOR ZX81 16K
HERE IS A VERY USEFUL PROGRAM,
THAT KEEPS A DETAILED RECORD OF
YOUR BANK BALANCE ,EXPENDITURE,
BUILDING SOCIETY SAVINGS AND
WILL ALSO GIVE A MONTHLY/ANNUAL
BALANCE SHEET OR RESULTS AS AND
WHEN REQUIRED.

DIM STATEMENTS ARE USED AND
THE LENGTH OF ARRAY CAN BE AD-
JUSTED TO SUIT INDIVIDUAL NEEDS.
ONCE THE PROGRAM HAS BEEN PUT
INTO MEMORY FOR THE FIRST TIME,
THE COMMAND RUN SHOULD BE USED
TO RESERVE THE AREAS OF MEMORY
FOR DIM STATEMENTS.HOWEVER ONCE
DATA HAS BEEN LOADED,USE GOTO
35 TO AVOID SETTING ALL DATA TO
ZERO.
THE INDEX IS PRESENTED,AND
NUMBERS 1 TO 7 CAN NOW BE INPUT
TO REACH DESIRED SECTION OF
PROGRAM.

BUILDING SOCIETY
SELECTED FROM 1 OR 5.
1- ALLOWS WITHDRAWAL AMOUNTS
WITHOUT CALCULATION OF INTEREST.
5-RESULTS SHOWN OR PROGRAM MAY
BE RUN AFTER RESULTS.

PROGRAM RUN.
THIS WILL:- SHOW MONTH NUMBER,
CALCULATE INTEREST OF BALANCE,
AND ADD TO BALANCE,ALSO TOTAL
INTEREST.
WHEN MONTH NUMBER SHOWS 2 OR 8,
THE TOTAL INTEREST IS RESET TO
ZERO.THIS IS TO FOLLOW BUILDING
SOCIETY PAYOUT,WHICH OCCURS
TWICE YEARLY.
ANY DEPOSITS ARE TAKEN CARE OF
FROM BANK BALANCE PROGRAM.
THIS PROGRAM IS ONLY INTENDED
TO BE RUN ONCE MONTHLY EITHER
AS ABOVE IF NO DEPOSIT IS TO
BE MADE,OR FROM BANK BALANCE
PROGRAM.
INTEREST RATE IS IN PROGRAM AND
IS CALCULATED AT 10.5 PER CENT.

BALANCE SHEET
SELECTED FROM 3 OR 7.
7-RESULTS ONLY.
3-RUNS PROGRAM-SHOWS MONTH NO.
TOTAL SALARY,TOTAL EXPENDITURE
ETC.
AFTER THE TWELTH MONTH,YEAR
NUMBERS ARE INCREASED BY ONE,
AND TOTAL C/F NOW BECOMES TOTAL
B/F FROM PREVIOUS YEAR.MONTH
NUMBER REMAINS AT ZERO FOR
RESULTS BUT REVERTS TO ONE IF
PROGRAM IS RUN.

EACH TIME PROGRAM IS RUN,
MONTHLY EXPENDITURE IN BANK BAL
PROGRAM IS RESET TO ZERO READY
FOR THE NEXT MONTH.
THE PROGRAM IS INTENDED TO BE
RUN ONCE MONTHLY,ALTHOUGH
RESULTS CAN BE SEEN ANYTIME.

BANK BALANCE
SELECTED FROM 2 OR 6.
2-RUNS PROGRAM,ALLOWS INPUTS
FOR EXPENDITURE,SALARY,BUILDING
SOCIETY PAYMENTS,AND INSRANCE.
IF B.S.PAYMENT IS MADE A JUMP
OCCURS TO B.S.PROGRAM AND BACK
TO BANK BALANCE PROGRAM.
PROGRAM IS RUN AS AND WHEN
REQUIRED.
6-RESULTS ONLY.
```

```
          INDEX
CHOOSE PROGRAM REQUIRED

         1  HBS
         2  BANK BAL
         3  BAL SHEET
         4  SAVE ON TAPE

      FOR RESULTS ONLY

         5 HBS
         6 BANK BAL
         7 BAL SHEET
```

```
         BAL SHEET 1982
MONTH NUMBER 1
TOTAL B/F FROM1981=2360.24
TOTAL PAY=970
TOTAL=3330.24
TOTAL EXP=222.32
MONTHLY BAL=747.68
CURRENT BAL=3107.92
         BAL C/F
         LLOYDS     =1703.04
         HBS        =937.37644
         SUN        =553
         TOTAL      =3193.4164
SELECT OPTION REQUIRED
          1  RERUN PROGRAM
          2  RETURN TO INDEX
```

```
         BAL SHEET 1982
MONTH NUMBER 12
TOTAL B/F FROM1981=2360.24
TOTAL PAY=970
TOTAL=3330.24
TOTAL EXP=222.32
MONTHLY BAL=970
CURRENT BAL=3107.92
         BAL C/F
         LLOYDS     =1703.04
         HBS        =937.37644
         SUN        =553
         TOTAL      =3193.4164
SELECT OPTION REQUIRED
          1  RERUN PROGRAM
          2  RETURN TO INDEX
```

```
         BAL SHEET 1983
MONTH NUMBER 0
TOTAL B/F FROM1982=3193.4164
TOTAL PAY=0
TOTAL=0
TOTAL EXP=0
MONTHLY BAL=0
CURRENT BAL=0
         BAL C/F
         LLOYDS     =1703.04
         HBS        =937.37644
         SUN        =553
         TOTAL      =3193.4164
SELECT OPTION REQUIRED
          1  RERUN PROGRAM
          2  RETURN TO INDEX
```

```
          HBS
MONTH NUMBER 4
MONTHLY INT=8.2738117
TOTAL INT=16.475856
BAL=953.85229
TOTAL WITHDRAWALS=0
TOTAL PAYMENTS=800

SELECT OPTION REQUIRED
          1  RERUN PROGRAM
          2  RETURN TO INDEX
```

```
          BANK BAL
BAL=1636.04
TOTAL EXP=67
TOTAL PAY=0

SELECT OPTION REQUIRED
          1  RERUN PROGRAM
          2  RETURN TO INDEX
```

```
  10 REM "HOME BUSINESS"
  20 DIM A(31)
  30 DIM B(10)
  35 CLS
  40 PRINT "HOME BUSINESS PROGRA
M"
  50 PRINT
  60 PRINT TAB 10;"INDEX"
  65 PRINT
  70 PRINT "CHOOSE PROGRAM REQUI
RED"
  80 PRINT
  90 PRINT TAB 8;"1    HBS  "
 100 PRINT TAB 8;"2   BANK BAL"
 110 PRINT TAB 8;"3   BAL SHEET"
 120 PRINT TAB 8;"4   SAVE ON TAP
E"
 130 PRINT
 140 PRINT TAB 7;"FOR RESULTS ON
LY"
 150 PRINT
 160 PRINT TAB 8;"5 HBS"
 170 PRINT TAB 8;"6 BANK BAL"
 180 PRINT TAB 8;"7 BAL SHEET"
 190 INPUT A(1)
 200 IF A(1)=1 THEN GOTO 270
 210 IF A(1)=2 THEN GOTO 700
 220 IF A(1)=3 THEN GOTO 1000
 230 IF A(1)=4 THEN GOTO 1270
 240 IF A(1)=5 THEN GOTO 525
 250 IF A(1)=6 THEN GOTO 875
 260 IF A(1)=7 THEN GOTO 1075
 270 CLS
 280 PRINT TAB 8;"HBS"
 290 PRINT "BAL=";A(2)
 300 PRINT "INPUT WITHDRAWALS"
 310 INPUT A(5)
 320 CLS
 330 LET A(2)=A(2)-A(5)
 340 LET A(8)=A(5)+A(8)
 345 PRINT TAB 8;"HBS"
 350 PRINT "BAL=";A(2)
 360 LET A(5)=0
 365 PRINT "SELECT OPTION REQUIR
ED"
 370 PRINT TAB 8;"1   RERUN PROGR
AM"
 390 PRINT TAB 8;"2   RETURN TO I
NDEX"
 400 INPUT A(1)
 410 IF A(1)=1 THEN GOTO 270
 420 IF A(1)=2 THEN GOTO 35
 460 LET A(3)=.00875
 470 LET A(6)=A(2)*A(3)
 480 LET A(7)=A(6)+A(7)
 490 LET A(2)=A(2)+A(6)+A(4)
 495 LET B(1)=B(1)+1
 500 LET A(9)=A(4)+A(9)
 505 IF B(1)=2 OR B(1)=8 THEN LE
T A(7)=0
 515 IF B(1)=13 THEN LET B(1)=1
 520 IF A(4)>0 THEN GOTO 780
 525 CLS
 530 PRINT TAB 8;"HBS"
 535 PRINT "MONTH NUMBER ";B(1)
 540 PRINT "MONTHLY INT=";A(6)
 550 PRINT "TOTAL INT=";A(7)
 560 PRINT "BAL=";A(2)
 570 PRINT "TOTAL WITHDRAWALS=";
A(8)
 580 PRINT "TOTAL PAYMENTS=";A(9
)
 590 PRINT
 600 PRINT "SELECT OPTION REQUIR
ED"
 610 PRINT TAB 8;"1   RERUN PROGR
AM"
 620 PRINT TAB 8;"2   RETURN TO I
NDEX"
 630 INPUT A(1)
 640 IF A(1)=1 THEN GOTO 470
 650 IF A(1)=2 THEN GOTO 35
 700 CLS
 710 PRINT TAB 8;"BANK BAL"
 720 PRINT "BANK BAL=";A(10)
 730 PRINT "INPUT EXP"
 740 INPUT A(11)
 750 PRINT "INPUT HBS PAYMENT"
 760 INPUT A(4)
 770 IF A(4)>0 THEN GOTO 460
 780 PRINT "INPUT SALARY"
 790 INPUT A(12)
 800 PRINT "INPUT SUN"
 810 INPUT A(13)
 820 LET A(14)=A(14)+A(11)
 830 LET A(21)=A(21)+A(13)
 840 LET A(15)=A(15)+A(12)
 850 LET A(10)=A(10)-A(11)+A(12)
-A(4)-A(13)
 860 LET A(4)=0
 870 LET A(11)=0
 875 CLS
 880 PRINT TAB 8;"BANK BAL"
 890 PRINT "BAL=";A(10)
 900 PRINT "TOTAL EXP=";A(14)
 910 PRINT "TOTAL PAY=";A(15)
 920 PRINT
```

continued on page 10

TECHNICAL GRAPH PLOTTING WITH THE ZX-81

by Reg Boor

The ZX-81 PLOT instruction is extremely convenient and saves having to write complex plotting routines. Nevertheless, in order to construct a technically useful graph some care has to be taken in drawing the graph paper and in scaling and placing the plot. Additionally, because of the size of an individual "pixel", there is a minimum useful computing interval which will avoid placing them on top of one another and so save computing time.

It is not suggested that the programs offered here are unique, just that they do the job neatly and form a basis, perhaps, for further enhancement using high resolution graphics. For now, however, it is assumed that the reader is content to use the keyboard facilities of his ZX-81.

I have chosen the plus sign with which to draw the graph paper. Any other symbol, or combination of symbols, seems cumbersome by comparison. The disadvantage, although easily overcome, is that a computed point cannot be plotted at a graticule intersection, because, as the ZX-81 handbook says, a screen element is divided up into four pixels "like a Battenburg cake". To recapitulate this particular point, the ZX-81 allows us the use of 704 T.V. screen elements each of which can display one keyboard character or four pixels. The graph paper program, lines 10 to 280, is given on figure 1. It is straightforward, merely a matter of establishing the graticule and leaving room for scales and titles. Traditionally these are around the edges of the graph and they are drawn so here, if you want a larger graph format there is nothing to prevent you drawing the graticule as large as the screen with the titles and scales inside it.

The program is given in open form, you will close it by entering your own titles in lines 210, 230, 250 and 280, and choosing values of X1 through X5 in line 190. Based on these X values you will also choose Y1, Y2 and Y3 on lines 150, 160 and 170. How this is done now follows.

We are going to plot computed values of the "dependent variable", Y, against the "independent" (or input) variable X, in mathematical terminology, Y is a function of X. This means that we choose a range of X over which we wish to examine the characteristics of Y, so we place X5 equal to the maximum value of X in the range of interest and estimate (or even calculate with our ZX-81!) the maximum value of Y over the range. We then give Y3 a value equal to, or higher than this maximum Y, noting that

Figure 1.

```
          MAIN TITLE

       SUBSIDIARY TITLE

  Y3++++++++++++++++++++++++++
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
  Y2++++++++++++++++++++++++++
    +    +    +    +    +    +
 Y  +    +    +    +    +    +
AXIS+    +    +    +    +    +
    +    +    +    +    +    +
  Y1++++++++++++++++++++++++++
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
    +    +    +    +    +    +
   0++++++++++++++++++++++++++
    0    X1   X2   X3   X4   X5
              X AXIS
```

```
  10 REM THE GRAPH PAPER
  20 REM SET UP THE AXES
  25 REM DRAW THE X AXES
  30 FOR N=0 TO 15 STEP 5
  40 FOR M=0 TO 25
  50 PRINT AT 4+N,4+M;"+"
  60 NEXT M
  70 NEXT N
  75 REM DRAW THE Y AXES
  80 FOR N=0 TO 25 STEP 5
  90 FOR M=0 TO 14
 100 PRINT AT 4+M,4+N;"+"
 110 NEXT M
 120 NEXT N
 130 REM Y AXIS SCALE
 140 PRINT AT 19,3;"0"
 150 PRINT AT 14,2;"Y1"
 160 PRINT AT 9,2;"Y2"
 170 PRINT AT 4,2;"Y3"
 180 REM X AXIS SCALE
 190 PRINT AT 20,4;"0";TAB 8;" X
1";TAB 13;" X2";TAB 18;" X3";TAB
 23;" X4";TAB 28;" X5"
 200 REM MAIN TITLE
 210 PRINT AT 0,10;"MAIN TITLE"
 220 REM SUBSIDIARY TITLE
 230 PRINT AT 2,7;"SUBSIDIARY TI
TLE"
 240 REM Y AXIS TITLE
 250 PRINT AT 11,0;" Y  "
 260 PRINT AT 12,0;"AXIS"
 270 REM X AXIS TITLE
 280 PRINT AT 21,12;"  X AXIS"
```

if Y3 is divisible by 3 and X5 by 5, we get nice scales and can complete lines 150, 160, 170 and 190 easily.

The calculation and plotting program, lines 290 to 380, is a given on figure 2, once again in open form. You have chosen the values of X5 and Y3 to insert in lines 320, 330 and 340, according to the function under examination, which itself is placed in line 350. Lines 320 and 330 evaluate two scales, in pixels per unit, on which are based the minimum computing interval (STEP) and the first X value, line 340, which ensures that pixels are neither placed on top of each other, nor plotted at graticule intersections. These scales are also used in line 370 to position the plot on the graph paper.

A typical 'O' level quadratic function is plotted on figure 3 as an example, it is shown together with the line alterations required to do the computation. Note that the range of interest of X is zero to 0.5, so that 0.5 is the value of X5 and that the maximum value of Y is 15, so Y3 equals 15. These numbers are divisible by 5 and 3 respectively so we obtain easy to read scales. The program still draws a graph even if X5 and Y3 are not so divisible but the scales would be difficult to read from and even to write on the graph paper!

A more elaborate example is shown in figure 4, on which are plotted the drag coefficients of three model aircraft with differing wing planforms, as characterised by their aspect ratios. The technicalities of this problem do not concern us here but the basic equation is in line 350, as previously, and you will see that there are two inputs to it, the lift coefficient, CL and the aspect ratio A. To tackle this we use two FOR NEXT loops, the outer one controls aspect ratio and does not need the scales SX and SY, the inner loop controls the X variable, which is now lift coefficient, or CL, and it works exactly like the previous example. Note also the two lines 390 and 400, inside the outer loop, which identify each of the three curves by printing the aspect ratio on the graph.

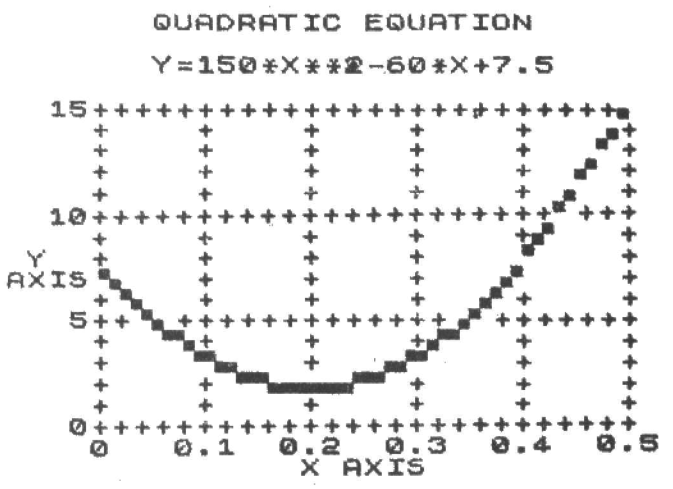
It is not necessary to plot at every possible pixel location, you can arrange to plot fewer points by modifying the end of line 340, after STEP. By inserting 2/SX, for instance, half as many points are plotted. Take care, by the way, to differentiate between the letters S and the figures 5 in this part of the program.

Finally, although the pixel is rather a blunt instrument with which to draw graphs, it is certainly adequate to illustrate the main characteristics of mathematical functions and, although the program given is constructed only to draw graphs in the positive quadrant (i.e. both X and Y positive throughout the range) it is hoped that the user who requires it will unravel the system of scaling and placing the plot, so as to allow him to illustrate any function. To have described this in detail would have made the article very complicated, whereas the recipe given for plotting positive functions works with ease.

Figure 2.

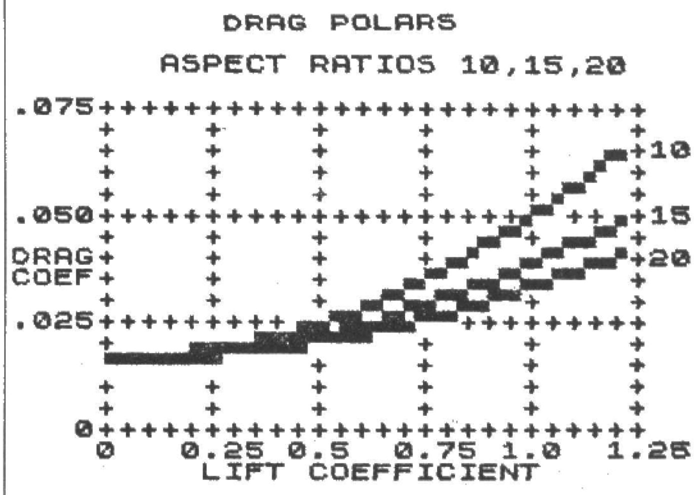
```
290 REM CALCULATE Y=FUNCTION(X)
320 LET SX=50/X5
330 LET SY=30/Y3
340 FOR X=1/(2*SX) TO X5 STEP 1
/SX
350 LET Y=FUNCTION X
360 REM PLOT THE RESULTS
370 PLOT 8+SX*X,5+SY*Y
380 NEXT X
```

Figure 3.




```
150 PRINT AT 14,2;" 5".
160 PRINT AT 9,2;"10"
170 PRINT AT 4,2;"15"
180 REM X AXIS SCALE
190 PRINT AT 20,4;"0";TAB 8;"0.
1 ";TAB 13;"0.2";TAB 18;"0.3";TA
B 23;"0.4 ";TAB 28;"0.5 "
200 REM MAIN TITLE
210 PRINT AT 0,7;"QUADRATIC EQU
ATION"
220 REM SUBSIDIARY TITLE
230 PRINT AT 2,7;"Y=150*X**2-60
*X+7.5"
320 LET SX=50/0.5
330 LET SY=30/15
340 FOR X=1/(2*SX) TO 0.5 STEP
1/SX
350 LET Y=150*X**2-60*X+7.5
```

Figure 4.




```
290 REM CALCULATE Y=FUNCTION(X)
295 FAST
320 LET SX=50/1.25
330 LET SY=30/0.075
335 FOR A=10 TO 20 STEP 5
340 FOR X=1/(2*SX) TO 1.25 STEP
1/SX
345 LET CL=X
350 LET CD=0.015+CL**2/(PI*A)
360 REM PLOT THE RESULTS
370 PLOT 8+SX*CL,5+SY*CD
380 NEXT X
390 LET A$="A"
400 PRINT TAB 30;VAL A$
410 NEXT A
420 SLOW
```

Just talking shop

Computers on the Altar in California.

Under the headline, "Why should the Devil have all the best micro's"? It was recently announced that **Church Computer Systems Inc.** of Sunnydale (Honest! no Kidding), California is now installing modular packaged systems, based upon the Vector Graphic computer, into churches in California.

Software includes, packages for Bible instruction, sermons, membership and attendance records, together with an accounts system for the collections, givings and disbursements. There is also a free magazine based on floppy disc to keep everyone in touch.

It sounds like a good idea, which of course could only have come from California, but I can't help having a laugh. Imagine the computer, housed alongside the altar (with perhaps a terminal in the confessional box) monitoring the transgressions of the flock, tailoring the sermon accordingly and recording its impact by the size of the following collection (the way they do things in California, thats not so far fetched as you might think).

But why should the computer stop there? With a bit of development and perhaps the addition of voice synthesis that magazine, based on floppy disc could actually contain the sermon. Originating on Mount Siniai (or more likely, Beverly Hills!), and descending each week to the gathered congregation, it could even take on the image of a holy tablet putting terror into the flock, and of course recording the appropriate response. (Which this being California, and it being a computer, it does by counting the hard cash in the till at the end of the day). Pretty soon that holy Vector would be the main communication channel to the Almighty, through which all supplications would be passed. Yes Sir, for a genuine, guaranteed reply within 24 hours.

Nippon Gakki enters Micro Market.

Yet another well known Japanese company has entered the microcomputer market. Nippon Gakki, well known in the West for its Yamaha brand of electronic organs, guitars and other musical instruments, has just launched an integrated home entertainments system based around its own microcomputer. Called the Yamaha Integrated System it comprises, the computer and a range of optional modules which currently include, a video disc player, an automatic piano, a musical keyboard and a range of electronic musical instruments. Available at the moment only on the Japanese market the computer retails at $4,400 (about £2,200) and the piano player at $1,500. You can be sure they will launch it onto the western markets when they think we can afford these prices.

It seems we will soon be able to compose and conduct a full, simulated, symphony orchestra without getting out of the armchair. I dread to think waht would happen if every house in the street got one. Brahms from those nice folk at number one. Martial music from those dreadful people who have just moved in to number 12. Welsh choral music from the Evan's at number 6, and if that horrible little schoolgirl up the other end does not get her full ensemble of recorders playing Greensleeves right soon I'll go mad.

30 Million Sales Forecast.

The latest survey of the market for personal computers in Japan, produced for a large Japanese microcomputer company, forecasts sales of 30 million systems into Japanese homes and businesses by the end of this decade. 30 million! That's one for every 3 Japanese. With such a large and prosperous home market it makes me wonder why they bother with us improverished Westerners.

If there's anyone left who still thinks that half the population lives on a bowl of rice a day they'd get one hell of a shock if he/she visited Japan today.

Low cost Floppies.

Good news for home based disc drive systems. American pioneer of floppies, Shugart, is reportedly preparing a low cost 5.25 inch mini floppy drive for launch within the next few weeks.

It will be assembled by Matshushita in Japan and is based on the popular SA200 drive.

Quantity prices are estimated to be as low as $90 per unit which means they could appear on the UK market at no more than twice this price.

Tandy TRS 88

Tandy are expected to take the wraps off their top secret 16 bit micro any day now. Called the TRS88 it is based on the highly rated M68000 processor chip and should cause quite a stir at the lower end of the micro business. It might even enable Tandy to fend off the strong pressure from Sharp for the number two position in the European market (Commodore is still tops), but not if they live up to form and fail to deliver until the end of the year.

Sharp-Rockwell Contract.

Finally, just to twist the knife in, it has recently been announced that Rockwell Corporation have signed a technology agreement with Sharp of Japan under which Sharp will license Rockwell to use its CMOS low power chip technology. Rockwell employees will be quality control procedures.

The contract comes just 10 years after Sharp signed a similar deal with Rockwell whereby the American company would train Sharp employees in the art of manufaturing its micro circuits. QED.

Time Travel

Readers who followed the serious articles on time travel in the July and August issues of E&CM will be interested to learn that the British Interplanetary Society, which numbers amongst its members some very eminent physicists and astonomers, has produced a design for a proton powered rocket which is theoretically capable of gradually accelerating to 600 million miles per hour, and more, thus enabling astronauts to benefit from time dilation effects in order to be able to reach distant stars.

One of the expeditions listed for future explorers is indeed to Barnard's star, as mentioned in the first article. The proton-powered rocket is envisaged to be erected in earth orbit and to consist of enormous sails, many miles across, which are used to capture protons in the universal cosmic radiation. These are concentrated into a beam of high energy particles which are then used to provide a constant accelerating force to the huge ungainly looking structure. Over a period of many months the space ship will reach these incredible speeds, and time as measured by the astronauts will slow down to a fraction of that on earth.

Clearly, we do not have the technology to build such a machine yet, but it may well come sooner than the 200 years mentioned in Roger Davies's articles.

Good news for Bubble memory.

A major boost for bubble memory technology has just been received from of all people, British Telecom. They have come to the conclusion that bubbles win out over discs in terms of reliability, performance and maintenance costs.

With their high reputation for specifying only the top grade products, British Telecoms announcement will do much to enhance the image of bubble technology after the denting it took last year when in quick succession Texas Instruments, National Semiconductor and Rockwell all announced they were pulling out of that market.

Plessey Microsystems have designed the bubble memory boards for eventual incorporation in the System X digital telephone exchange we are so patiently waiting for. There will be 18 bubble memory boards in each system X unit and each board has a 1 mega-byte memory built up from 256K elements supplied by Motorola. Plessey intend to switch over as soon as possible to 1 Megabit elements also supplied by Motorola, with Hitachi acting as second source.

This further re-enforces my prediction made last October, at the time TI etc were pulling out, that bubble memories will finally replace floppy discs by the end of this decade.

UPDATE

Continued from Page 31.

KITS. Including printed circuit boards and assembly instructions.

Name	Price inc.VAT (pounds)	Memory size (000)	Power Supply Inc.	Case Inc.	Keyboard Inc.	Display Inc.
SinclairZX-81	50	1	no	yes	yes	no
Atom	140	2	no	yes	yes	no
Microtan 65	80	1	no	no	yes	no
Tuscan	270	8	yes	yes	yes	no
Nascom	419	16	yes	no	yes	no
Power-Tran	258	3	yes	yes	yes	no
Compukit	205	4	yes	no	yes	no

Professional Quality Imported Models.
(Note. Printer is <u>not</u> included unless indicated).

Name	Model No.	origin	CPU	Memory (RAM)	DOS	Disc Drive.	Bus	Price (pounds)
Altos	ACS8000	USA	Z80	208K	CP/M	Winnie	own	8,195(23)
Al-Micro	ABC26	JAP	Z80	64	CP/M	2x5"	own	3,195
Alphatronic	P2	GER	8085	48	own	5 "	own	1,500
Apple.	II	USA	6502	64	own	5 "	SS50	3,000
Aristocrat.		USA	Z80	180	CP/M	2x5"	S100	4,000
Commodore	Pet II	USA	6502	48	own	5 "	SS50	3,500
Compucorp	655	USA	Z80	64	CP/M	5 "	IEEE	
Cromemco	2	USA	Z80	64	own	5 "	S100	
DataGeneral	Enterprise	USA			own	2x5"	own	$7,195(1)
DMS inc.	DSC4	USA	Z80	512	CP/M	8 "	S100	3,995
Fujitsu	Micro8	JAP	6809	64	UCSD	2x5"	own	$2,375
Gnat	10		Z80	64	CP/M	5 "	S100	3,000
Heath	Z89	USA	Z80	64	CP/M		S100	1,500
HewletPackard	HP85	USA	8085	32	own	5 "	IEEE	1,935
HewletPackard	HP125	USA	Z80	64	CP/M	2x5"	own	4,372(1)
Hitachi	MB6809	JAP	6809	32	own		own	1,330
IBM	Sys23	USA	---		own	2x8"	own	$9,835(1)
Kontron		GER	Z80	64	KOS	Winnie	own	(2)
NEC	PC8000	JAP	Z80	64	CP/M	2x5"	own	2,000
North Star	Horizon	USA	Z80	56	CP/M	2x5"	S100	4,000
OhioChallenger	3	USA	Z80	48	CP/M	8 "	own	1,500
Oki	800	JAP	Z80	64	CP/M	2x5	own	4,299(1)
Osborne	I	USA	Z80	64	CP/M	2x5"	own	1,500
Panasonic	JD700U	JAP	8085	56	own	8 "	own	4,000
Pasca	640	JAP	Z80	64	CP/M	2x8"	own	3,300
Sharp	PC3200	JAP	Z80	64	CP/M	2x5"	own	3,500
Superbrain.		USA	Z80	64	CP/M	5 "	S100	1,900
Sord	M223	JAP	Z80	64	CP/M	8 "	S100	4,000
Tandy	ModII	USA	Z80	64	CP/M	8 "	own	2,300
Tandy	ModIII	USA	Z80	48	TRSDOS	2x5"	own	1,799
Toshiba	T-200	JAP	8085	64	CP/M	2x5	own	3,000
VectorGraphic	5005	USA	Z80	64	CP/M	Winnie	S100	5,399(23)
VectorGraphic	2600	USA	Z80	64	CP/M	2x5"	S100	3,345
Xerox	Worm	USA	Z80	64	CP/M	2x5"	own	$3,000

(1) Includes matrix printer.
(2) Includes Winchester hard disc plus floppy back-up.
(3) Multi-user, Multi-tasking capability.

Building BASIC

• Mike James continues his series designed to assist electronics enthusiasts write their own computer programmes in Basic.

Part Six

By Mike James

Logic

This month we examine logic. Many people believe that computers and computer programmers spend all of their time dealing with logic. If you've been following the series you'll know that this is far from the truth. To write programs in BASIC, or any other computer language, does not require any understanding of traditional logic. For the subject of digital electronics however things are very different. The design of any digital equipment requires at least an intuitive understanding of logic. BASIC can help with digital electronics because it can evaluate logical expressions the same way it can evaluate arithmetic expressions.

After learning about logic in BASIC it is easy to find many other uses for it apart from helping with digital design — so while programming can help with electronics the practice helps the programming!

Boolean logic

There are many different types of logic but the one that concerns us here is one of the simplest — Boolean logic. Boolean logic is based on the simple fact that a statement is either true or false. We may actually not know if a particular statement is true or false but for boolean logic to work all that matters is that it must be one or the other i.e. true or false are the only possibilities. If this seems obvious to you then don't worry too much because it is!

Consider the BASIC statement A > 0. Does this say "the variable A IS greater than zero"? Suppose A is to set equal to one earlier in the program then A>0 is true, but if we set A equal to minus one then A>0 is false. It should be clear now that A > 0 doesn't mean that we are saying A IS greater than zero but it is a statement which may be true or false. A statement which may be true or false is known as a **Boolean expression**. You may be wondering where you could use an expression like A>0 well the answer should be obvious:

```
10 IF A>0 THEN PRINT "A IS BIGGER THAN ZERO"
```

We have been using boolean expressions all the time within IF statements. The general form of the IF statement can now be expressed as

```
IF boolean expression is true THEN statement
```

The boolean expressions that we already know are all based on the relational operators introduced when we dealt with the IF statement. To recap:

=	equals	A = B
<	smaller	A < B
>	greater	A > B
<>	not equal	A <> B
<=	smaller or equal	A <= B
>=	greater or equal	A >= B

Our new understanding of these means that each is a statement which may either be true or false. Notice that the sign "=" has two meanings in BASIC. It can be used to mean signment i.e. LET A=0 or it can be used as a relational operator i.e. IF A=0 THEN etc. In the first case A IS set equal to 0 and in the second A is unchanged and instead a true or false result is returned. Also remember that the relational operators can be used to compare strings as well as numbers — see BB part 4.

Boolean operators

So far boolean expressions have given us nothing but a reinterpretation of old facts. If this was all there was to Logic it would hardly be worth the bother!

Consider the following short program:

```
10 PRINT "INPUT TWO RESISTANCE VALUES";
20 INPUT R
30 INPUT S
40 IF R<0 THEN PRINT "RESISTANCE MUST BE
   BIGGER THAN ZERO!"
50 IF S < 0 THEN PRINT "RESISTANCE MUST BE
   BIGGER THAN ZERO!"
      rest of program
```

At lines 40 and 50 we test to see if the two resistance values are smaller than zero. If you examine these two lines carefully you might think that there is some repetition because the same thing happens if either resistor is less than zero and if both are less than zero the message is printed twice. As a simple exercise the reader might like to try to change the program to print the message just once no matter what. From a common sense point of view it would be nice if we could write in place of lines 40 and 50:

```
40 IF R<0 OR S<0 THEN PRINT "RESISTANCE
   MUST BE BIGGER THAN ZERO"
```

The part of the statement between the IF and the THEN is still a boolean expression, that is it can either be true or false. To see that this is the case we can examine what makes the IF statement carry out the statement following the THEN.

R<0	S<	THEN taken
False	False	No
False	True	Yes
True	False	Yes
True	True	Yes

By examining the above table it should be clear that the THEN course of action is taken if either of the two inequalities is true and this is of course what we mean by OR! Going back to the definition of the IF statement the boolean expression R < 0 OR S < 0 must be true if the statement following the THEN is carried out. We can now write the earlier table as:

R<0	S<0	R<0 OR S<0
False	False	False
False	True	True
True	False	True
True	True	True

This is called a truth table and it is one of the basic ways of understanding logic expressions. Apart from understanding a logic table we have also discovered our first logical operator — OR. It is worth pausing for a moment to think about the similarities between what we have just done and the more familiar evaluation of arithmetic expressions. In arithmetic we write A + B and everyone understands that for various values of A and B we could work out the result of A + B. We could write down an "arithmetic table" listing all the values that A and B could have and the result A+B. This would take rather a long time however as that number of values that A and B can take on is infinite! (i.e. 0, 1, 2, 3, 4, 5.. even if we only want to work with whole numbers.) In case of logical expressions we don't have the same trouble as each variable can only take on two values — true or false — and we can write the truth table for A OR B very easily.

Logical variables

At the end of the last section we introduced a new idea that deserves further mention. Going back to our analogy with arithmetic, the two values, true and false, are logical constants in the same way 0, 1, 2, 3, 4, ... etc are arithmetic constants. It would be nice if BASIC provided us with logical variables that we could set equal to logical constants e.g.

```
10 A = TRUE
20 IF A THEN PRINT "A TRUE"
```

You may find the above program difficult to read and it may look a little strange, but you should be able to understand what it's getting at. The variable A is a logical variable, it can only store the values true/false, and at line 10 it is set equal to the constant true. At line 20 the IF statement evaluates the boolean expression A and finds that it is true so the THEN is taken.

The trouble is that most BASICs do not have logical variables so this explanation is not exactly correct. It is however correct in spirit as we shall see. Although the two values that a boolean expression can take on are usually called true and false, these names are entirely arbitrary. We could call them "plink" and "plonk" or anything else without altering boolean logic at all. More to the point we could call them 0 and 1 and use ordinary arithmetic variables to hold logical values! This is the method used by most BASICs. The only extra complication is that not everyone can agree on 0 and 1 and some use 0 and -1 or -1 and +1 etc, etc. The differences are irritating but not too important. A brief summary of how the different BASICs handle Boolean logic can be seen in table one.

(The "full evaluation range" column will be explained later.) For the rest of the article we will assume that 1 is true and 0 is false. With this decided our earlier program becomes.

```
10 A = 1 20 IF A THEN PRINT "A TRUE"
```

It is now possible for us to use the computer to produce the truth table for OR.

```
10 FOR I = 0 TO 1
20 FOR J = 0 TO 1
30 PRINT I;" ";J" ";I OR J
40 NEXT J
50 NEXT I
```

Logical Operators

We arrived at our first logical operator — OR by appealing to common sense. It would be possible to continue to apply common sense and derive the other often-used logical operators, but to save time and avoid tedium the following BASIC program will print truth tables for OR, AND and NOT:

```
10 PRINT "TRUTH TABLE FOR AND-OR-NOT"
20 FOR I = 0 TO 1
30 FOR J = 0 TO 1
40 PRINT I;" ";J;" ";I AND J;" ";I OR J;" ";NOT I
50 NEXT J
60 NEXT I
```

AND used between two logical variables will result in the expression being true only if both variables are true. NOT is a unary operate (see BB part one) and simply changes the truth value of a single variable into the other value — i.e. NOT changes true into false and false into true. We have already dealt with OR. These three basic logical operators are all we need to express any boolean logic. At a more practical level AND, OR and NOT are all we need to express any set of conditions for an IF to carry out the statement following the THEN.

Logical operators can be combined into expressions in much the same way as arithmetic operators. The only thing you have to be careful of is the priority of the operators (see BB part 1) most BASICs define the priorities so that, unless you use brackets, NOT is done first then AND and finally OR. For example NOT(I) AND I, NOT(A < 0) AND (B < 0), (A = 0) OR (A = 1) AND (B = 0)) are all valid logical expressions. The rules for manipulating such expressions are not difficult to learn and if you're interested there are many good books on simple logic that will help you become proficient in manipulating logic. For the purposes of programming, however, becoming an expert logician is more than we require — the computer can always work any difficult logic out for us! For example if you need to know the truth table for NOT(I) AND I then change line 40 in the previous program to:

```
40 PRINT I;" ";J;" ";NOT(I) AND I
```

If you're lucky enough to own a ZX81 or use a version of BASIC that has a full VAL or EVALuate instruction, try changing the previous program by:

```
10 INPUT A$
40 PRINT I;" ";J;" ";VAL(A$)
```

This will allow you to type in ANY logical expression of I and J and print out its truth table because the function VAL works out the expression contained by the string A$. If you want to work out a truth table with three variables all you have to do is add a FOR loop with a variable K and so on for four variable, five . . . until you run out of memory or patience.

Simplifying Expressions

There is one thing that a computer cannot do very easily for you and that is to simplify boolean expressions. Sometimes while working out what should go inside an IF

BASIC	True	False	range
Microsoft V5	0	-1	-32768 to 32767
ZX81	1	0	see below
APPLE	1	0	-
ATOM	1	0	-65536 to 65535

BASIC	True	False	range
Microsoft V5	0	-1	-32768 to 32767
ZX81	1	0	see below
APPLE	1	0	-
ATOM	1	0	-65536 to 65535

statement you might come up with something like:

10 IF NOT (A < 0) THEN....

You might have said to yourself, "If A isn't smaller than zero then . . ." and translated "isn't smaller than zero into BASIC as NOT (A < 0). There is nothing wrong with this method of constructing IF statements — it's the way we ALL do it — but if you've been programming for a while you notice that NOT (A<0) is the same thing as A>= 0. Put into words "A isn't smaller than zero" is the same thing as "A is bigger or equal to zero". By making this simple change you can make the program slightly simpler and faster to run. There are a whole host of such simplifications that you can make to a complex logical expression but it's up to you to decide if it's worth it. This is very similar to simplifying arithmetic expressions before using them in a program — it's not wrong to use A*B+A*C rather than A*(B+C) but the latter is faster. We all learn how to simplify arithmetic expressions at school but logical expressions are something else! Fortunately we are saved by the fact that in practice the logical expressions that crop up are fairly simple and can be altered by using some common sense.

Some rules for manipulating boolean expression might be useful however:

Relations

1. NOT(A=B) = A<>B
2. NOT(A<B) = A>=B
3. NOT(A>B) = A=<B

Logic

1. NOT (NOT (A)) = A
2. A OR (B AND C) = (A OR B) AND (A OR C)
3. A AND (B OR C) = (A AND B) OR (A AND C)
4. NOT (A OR B) = NOT (A) AND NOT (B)

The rules for relations are easy enough to understand but the logic ones might be less obvious. The first logic rule says that to NOT something twice leaves it unchanged. The second and third rules are easier to understand if you compare it to arithmetic — A*(B+C)=(A*B)+(A*B) — both AND and OR can be factorised just like multiplication. The final rule is the most difficult and it is known as De Morgan's law. It is important because it provides the link between AND and OR in that any expression involving OR can be changed into one involving AND and vice versa. This isn't a complete list of rules for manipulating logic but it will see you through most logical problems.

The other logical operators

AND, OR and NOT are all the logical operators that you NEED but sometimes it is useful to give names to often used combinations of them. Moreover, Not many BASICs offer you more than AND,OR and NOT so it is important for you to know how to make up these more complicated operators.

NOT (A OR B) = A NOR B
NOT (A AND B) = A NAND B
(NOT (A) AND B) OR (A AND NOT(B)) = A EOR B

The first two examples are easy, the third, EOR looks impossible! In fact EOR — exclusive OR — is one of the most useful logical operators. To find out what it does a truth table helps —

A	B	A EOR B
0	0	0
1	0	1
0	1	1
1	1	0

Looking at the last column you should be able to see a similarity with the truth table produced by OR. The difference is that EOR is true (i.e. 1) only when one of A or B is true and OR is true if one or both are true.

Electronics and logic

At the start of this article it was explained that logic is used in the design (and debugging) of digital circuitry. In this section I will try to explain the connection between programming and hardware logic.

Digital circuits are built up from a range of integrated circuits which provide elementary logic functions. For example in the 74 range the 7400 contains four NAND gates. These provide the same operation as our NOT (A AND B) expression did in the last section, except that instead of 0 and 1 representing true and false two voltage levels (5V and 0V) are used and A and B are two inputs to the circuit. So if we have a network of simple logic integrated circuits we can write down a boolean expression to represent them and use a program, based on the one given earlier, to work out a truth table and hence what outputs you get for any input. This is of course much easier than building the circuit.

This idea of translating a piece of simple digital electronics to a boolean expression is the basis of a very powerful technique that can be used to try out any digital design. The reason why we have to extend the method is that most even slightly advanced digital equipment goes beyond "static" logic by using oscillators and pulse generators to "run" the logic circuits. So far we have not introduced a way of generating such pulses, or clocks as they are often called, but it's not too difficult and would make a very interesting project for the reader to tackle.

Evaluation Range

This section is a little more advanced than the rest of the article so you may want to skip it until some later time. What happens if you try something like:

10 A=6
20 B=7
30 PRINT A AND B

So far we have only discussed logical operations involving values like 0 and 1. What happens if you try ANDing numbers like 6 and 7 depends on the version of BASIC that you are using. Some will treat the numbers as binary numbers e.g. 6=110 and 7 = 111 and carry out the logical operation on each pair of bits in turn e.g. bit one of 6 is 0 and bit one of 7 is 1 so the result of ANDing them together is 0 and so on with the second and third pairs of bits giving 110 as the answer. The result of this bitwise logical operation can of course be treated as another binary number and converted back to decimal e.g. 110 is 6. Any BASIC that works this way will have a largest number that it can deal with and this is listed in the table given earlier under the heading of "full evaluation range".

The ZX81 is very special in its use of logical operations on extended ranges (i.e. other than 0 and 1). If you try:

10 PRINT A AND B

you will find that if B is 0 the result is zero but if B is anything else the result is A. This remarkable feature also works for strings.

10 PRINT A$ AND B

will print nothing (i.e. the null string) if B is zero and A$ if B is any other value. This is particularly useful if you're trying to fit a program into a 1K ZX81 because instead of

10 IF B<>0 THEN PRINT A$

you can use

10 PRINT A$ AND B

The other logical operators on the ZX81 are also special — A OR B is A if B is 0 and 1 if B is anything else, NOT A is 0 if A is not zero and 1 if it is. Neither of these can be used with strings but they are very powerful statements and deserve further study, however this comes under the heading of "very clever programming"!

Conclusion

We have introduced the topic of boolean logic in programming at a fairly simple level (apart from the last section) and you will probably be relieved to hear that it's at the simple level that it's most often used. Using ANDs and ORs should make your programs easier to read and smaller but do take care to check that the logical expressions that you use mean exactly what you want. Logic can sometimes be confusing!

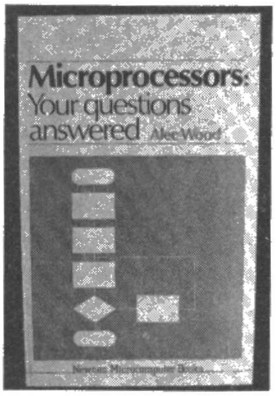
Next month:

More advanced BASIC.

My emphasis this month is on practical issues and getting a better understanding of electronics – either through some very sound explanation or through actually building circuits yourself. I also include a children's book suitable for enquiring young minds.

Microprocessors: Your Questions Answered

by Alec Wood, 155 pages, £4.95 Published by Newnes Technical Books, 1982.

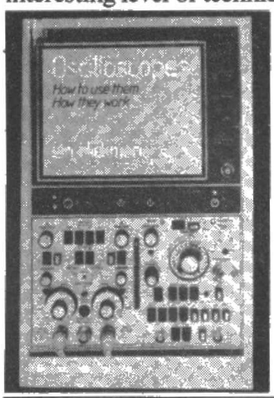


I was very pleased to find a book which approaches the subject of micros in such a straightforward and comprehensible way. Alec Wood "has set out to dispel the mystique that surrounds the microprocessor" and he has actually suceeded rather well. The book starts off by explaining what microprocessor chips are and explains the different types of logic used. This is done with the aid of diagrams that the electronics enthusiast will find easy to understand. The second chapter, about hardware, shows how the different microprocessors are related to one another and introduces other parts of the system that so often remain as lightly dismissed jargon terms which have you wondering which technology they are referring to, such as bus and port! The next chapter deals with software which explains how high level language, such as BASIC, is converted into assembly language, hexadecimal code and machine code. I found the explanations given of machine code and hexadecimal very clear. The chapter on logic explains the logic gates with the help of neatly presented diagrams. The next three chapters cover aspects of computation, there is then a chapter devoted to memory, one to control (covering interrupts and the clock) and one to input and output (dealing with communication with the external world). The final chapter is about further programming techniques and it's still easy to follow! This book has clear presentation throughout and once you've read it from cover to cover you need never be bewildered by microprocessors again.

Oscilloscopes

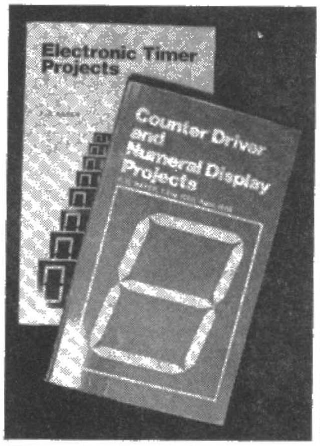
by Ian Hickman, 122 pages, £3.45 Published by Newnes Technical Books, 1981.

An oscilloscope is a fairly expensive piece of test equipment but a lucky enthusiast may have access to one — at work, at school or through a friend and some will even buy their own. And of course lots of people have a professional interest in scopes. This book will be of interest to anyone who may ever want to buy or just operate a cathode-ray oscilloscope. It is of course possible to use scopes for years without ever understanding the principles by which they operate, but Hickman's book will make the subject more interesting and allow you to make the most of their features. In the first chapter the basic principle of "oscillography", that of displaying a voltage that is varying using two-dimensional, or co-ordinate, geometry, is explained. Chapter two introduces the "basic" oscilloscope, presenting its block diagram and explaining its controls. From here a jump is made to the advanced oscilloscope which is considered in chapter three in technical detail. The next chapter examines accessories — probes, cameras, calibrators and graticules — all fairly briefly. Chapter 5 is about using oscilloscopes and choosing the right equipment for your application — a topic covered further in the next chapter. Many examples of output waveforms are presented. The last part of the book is devoted to how the oscilloscope works. This book is illustrated throughout with photographs and diagrams and covers its subject at an interesting level of technical detail.



Counter Driver and Numerical Display Projects, 91 pages, 1980. Electronic Timer Projects, 88 pages, 1981.

both by F G Rayer, £1.95 Published by Bernard Babani Ltd.



These books each present a collection of fairly traditional circuits all of which use tag board or point-to-point wiring on perforated board rather than PCBs. In the first one the methods of display covered are nixie tubes (neon), seven segment LEDs (solid state) and minitrons (filament). Rayer omits LCDs which are given no mention at all. The book explains well the principles involved but now that one can buy big chips that do in one the tasks that some of the circuits have been constructed for, it is likely to have limited appeal. However, for someone who wants to learn the fundamentals of drivers and displays or for someone who wants a cheap way of constructing a piece of equipment it is a good, attractively priced book.

When he deals with electronic timing circuits, Rayer presents a variety of simple circuits, some of which can be combined to give fairly complicated ones. LEDs for displays are used in many of the projects so if you've worked through the counter driver volume you'll be able to make use of your experience. The range of applications includes a car trip timer, an audio visual metronome and a darkroom timer.

Computers

by Brian Reffin Smith, 32 large pages, £1.85 Published by Usborne, 1981.

This is the first children's book on computers that I've looked at and I found it more fun than some of the other volumes I've been sent recently. For a start it has brightly coloured illustrations and has more pictures than text on every page. There are also puzzles, projects and games. Meanwhile it serves its purpose as an introduction to computers, the way they work, the way to give instructions to them and the variety of things a computer can do. "The Usborne Guide to Computers" book brings home to me the fact that the current generation of children are going to grow up taking microprocessors for granted. This book is suitable for youngsters from about age ten — but if they are your children make sure you read it first.

If you're still staggering through the computer jungle and not getting sensible answers to your questions, we have some good news:

Now you can turn to **professional** people who are capable of giving you sound advice on practically all aspects of popular computing.

They all have one thing in common:

They are **COMPUTERS FOR ALL** dealers.

A Computers for All dealer is different from the normal Computer retailer.

Not surprisingly he won't try to sell you things like cameras or cosmetics; stationery or sealing wax.

He will, however, be capable of answering sensibly almost any question you have on computers and computing, and have readily available a wide range of popular computers, hardware, software, books, and peripherals.

So why not call in at your local **COMPUTERS FOR ALL** dealer today? He can lead you in the direction you want to travel.

The shops where people matter:

Akhter Instruments, Unit 19, Arlinghyde Estates, South Road, Harlow, Essex. 0279 412639. **Anirog Computers,** 26 Balcombe Gardens, Horley, Surrey. 02934 6083. **Audio & Computer Centre,** 7 Peter Street, St. Helier, Jersey, Channel Islands. 0534 74000. **Automation Services (S. Wales),** 3 Wermeys Road, Penysfai, Bridgend, S. Wales. 0656 720959. **Bits & Bytes,** 44 Fore Street, Ilfracombe, N. Devon EX34 9JD. 0271 62801. **Carlton Computers,** 4 Swansons Road, Great Yarmouth, Norfolk NR30 3NQ. 0493 58898. **Computasolve,** 8 Central Parade, St. Marks Hill, Surbiton, Surrey. 01-390 5135. **Computer Corner,** 15 The Broadway, Wickford, Essex. 03744 3710. **Computer Systems (Torbay),** Pump Street, Brixham, Devon. 08045 6565/6. **Computers for All,** 72 North Street, Romford, Essex. 0708 752862. **Crystal Computers,** 209 Union Street, Torquay, Devon. 0803 22699. **D. V. Martin Ltd.,** 13 Bridge Street, Belfast, N. Ireland BT1 1LT. 0232 226434. **Dan Evans (Barry) Ltd.,** 81 Holton Road, Barry, South Glamorgan. 0446 734242. **Emprise Ltd.,** 58 East Street, Colchester, Essex. 0206 870353. **Emprise Ltd.,** 3a Baddow Road, Chelmsford, Essex. 0245 356834. **Fal-Soft Computers,** 8 St. George's Arcade, Falmouth, Cornwall. 0326 314663. **Home Computer Centre (Ross Records),** 13 Kingston Road, Portsmouth, Hampshire. 0703 819515. **Impulse Micro Systems Ltd.,** 6 Central Chambers, Cooks Alley, Wood Street, Stratford-upon-Avon. 0789 295819. **Jade Computers,** Coombend, Radstock, Bath, Avon. 0761 32570. **Kelly's Computermarket,** 227 Dartmouth Road, Sydenham, London SE26 4QY. 01-699 4399/6202. **Kenneth Ward Computers,** KF&R House, London Road, Ascot, Berkshire. 0990 22275. **Medway Computers,** 141 New Road, Chatham, Kent. 0634 826080. **Mercator Computer Systems,** 3 Whiteladies Road, Clifton, Bristol. 0272 731079. **Mobile Micros,** 2 Castle Street, Thornbury, Bristol. 0454 418383. **Steve's Computer Co. Ltd.,** Castle Arcade, Cardiff. 0222 41905. **The Computer Centre (BMS) Ltd.,** 37d&e, Robertson Street, Hastings, East Sussex. 0424 439190. **Twillstar Computers,** 17 Regina Road, Southall, Middlesex. 01-574 5271. **Weytech,** 20 St. Edmunds Street, Weymouth, Dorset. 03057 79881.

COMPUTERS FOR ALL